1-1-2004

Simples and gunk.

Kris, McDaniel
University of Massachusetts Amherst

SIMPLES AND GUNK

A Dissertation Presented

by

KRIS MCDANIEL

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

September 2004

Department of Philosophy

SIMPLES AND GUNK

A Dissertation Presented

by

KRIS MCDANIEL

Approved as to style and content by:

Phillip Bricker

Phillip Bricker, Chair

Lynne R. Baker

Lynne R. Baker, Member

Jonathan Schaffer, Member

Angelika Kratzer, Member

Phillip Bricker

Phillip Bricker, Department Head
Philosophy

DEDICATION

To Hud Hudson, friend and mentor.

ACKNOWLEDGMENTS

I would like to thank Phillip Bricker. I have learned a tremendous amount about metaphysics and philosophical methodology from Phillip Bricker. He was a terrific teacher and advisor.

I would also like to thank the rest of my committee: Lynne Rudder Baker, Angelika Kratzer, and Jonathan Schaffer.

I would like to thank Ben Caplan, who read the entire dissertation. Ben provided me with detailed critical comments on each chapter, which greatly improved the manuscript.

I thank the following for helpful comments on various parts of the dissertation: Mark Barber, Jake Bridge, Cody Gilmore, C.L. Hardin, Chris Heathwood, John Heil, John Hawthorne, Eric Hiddleston, Hud Hudson, Marcy Lascano, Ishani Maitri, Rhonda Martens, Ned Markosian, Carl Matheson, David Robb, Tim Schroeder, Theodore Sider, Stephan Torre, Brant Van der Gaast, and Ryan Wasserman.

I thank the Australasian Journal of Philosophy and Oxford University Press for permitting me to use material from the following articles:

McDaniel, Kris. 2004. "Modal Realism with Overlap", Australasian Journal of Philosophy (82): 137-152.

McDaniel, Kris 2003a. "Against MaxCon Simples", Australasian Journal of Philosophy (81): 265-275.

I thank Analysis and Blackwell publishing for permitting me to use material from the following article:

McDaniel, Kris. 2003b. "No Paradox of Multi Location", Analysis (63.4): 309-311.

Finally, I want to thank Nina Stoeckel for her patience and support.

ABSTRACT

SIMPLES AND GUNK

SEPTEMBER 2004

KRIS MCDANIEL, B.A., WESTERN WASHINGTON UNIVERSITY

Ph.D., UNIVERSITY OF MASSACHUSETTS AMHERST

Directed by: Professor Phillip Bricker

An object is a *simple* if and only if it has no proper parts. An object is *gunk* if and only if every proper part of that object itself has a proper part. In my dissertation, I address the following questions.

(1) The concepts of simples and gunk presuppose the concept of parthood. What is the status of this concept? his question itself divides into the following: does the concept of parthood have universal applicability, so that, just as every object is self-identical, every object has parts? Finally, is the concept of parthood *univocal*, or are there different notions of parthood, each of which is defined on distinct ontological categories? I argue that the concept of parthood has univocal. I also argue that there is some evidence that the concept of parthood has universal applicability.

(2) I address the Simple Question, which is "under what circumstances is it true of some object that it has no proper parts?" I argue against several popular answers to the Simple Question, such as the view that simples are all and only point-sized objects, and the view that simples are maximally continuous material objects. I defend *the Brutal View*, which holds that there is no true, finitely expressible, and informative answer to the Simple Question. In short, there is no criterion for being a simple. Along the way, I address the question of whether extended simples, i.e., simples that are

extended in space, are possible. I argue that one popular argument against the possibility of extended simples is unsound.

(3) I address the question of whether both simples and gunk are possible. I argue that it is metaphysically possible that material objects be composed of gunk.

TABLE OF CONTENTS

INTRODUCTION

An object is a *simple* if and only if it has no proper parts. An object is *atomless gunk* if and only if every proper part of that object itself has a proper part. In this dissertation, I address three questions about simples and atomless gunk.

First, the concepts of simples and atomless gunk both presuppose the concept of parthood. What is the status of this concept? *Compositional monism* is the view that there is exactly one fundamental parthood relation that answers to this concept. According to the compositional monist, the concept of parthood is *univocal*. The *compositional pluralist* disagrees. One kind of compositional pluralism holds that there are different notions of parthood, each of which is defined on distinct ontological categories. In chapter one, I defend compositional monism from a series of attacks.

Second, I address the Simple Question, which is "under what circumstances is it true of some material object that it has no proper parts?" I argue against several popular answers to the Simple Question, such as the view that simples are point-sized objects, and the view that simples are maximally continuous material objects. I defend *the Brutal View*, which maintains that there is no true, finitely expressible, and informative answer to the Simple Question. In short, there is no non-mereological criterion for being a simple. The defense of the Brutal View occupies chapter two.

Along the way, I address the question of whether extended simples, i.e., simples that are extended in space, are possible. I argue that the standard arguments against extended simples are unsound. I also present reasons to believe that they are possible. This project is taken up in chapter three.

Third, I address the question of whether material atomless gunk is possible. An object is material atomless gunk just in case it is atomless gunk and every proper part of it is located in spacetime. I discuss several recent attempts to disprove the possibility of material atomless gunk. I argue that these arguments fail. However, I also present a novel argument for the conclusion that it is impossible that spacetime be gunky. If it is possible for material objects to be gunky, then it must be possible for gunky objects to reside in non-gunky regions of spacetime. I argue that we have no reason to think that this latter state of affairs is impossible. So, even if we have good reason to think that gunky spacetime is impossible, we do not have a reason to reject the possibility of gunky material objects. This project is taken up in chapter four.

No serious metaphysical inquiry can proceed without presuppositions. Although it is impossible to provide an exhaustive list of all of the theses I take for granted in this dissertation, it seems reasonable to at least discuss the ones that are directly related to the project. What follows is my attempt to list those presuppositions that have shaped what I have to say about parthood, simples, and gunk.

The first set of assumptions concern ontological categories. I believe in ontological categories, that is, I believe that there are fundamental kinds in the world. Ontological Categories are kinds of things that satisfy the following conditions:

(OC1) *Exhaustiveness*: Every object belongs to at least one ontological category or decomposes without remainder into objects that belong to exactly one ontological category.[1]

(OC2) *Exclusivity*: No object belongs to more than one ontological category.

(OC3) If x belongs to an ontological category, then every part of x belongs to that category.

(OC4) If x is composed of the *ys*, and each of the *ys* belongs to category C, then x is belongs to C.[2]

(OC5) *Fundamentality*: Ontological categories carve nature at the joints; they are fundamental kinds.

An *ontological scheme* is a list of ontological categories. One of the basic projects of metaphysics is to provide principles telling us what ontological categories there are and what distinguishes the categories from one another. This project is *ontology*.

Second, I hold that whether a particular ontology is correct is not up to us. The correctness of a particular ontology is not dependent on our thoughts, hopes, desires, the kind of language we speak, or the form of life that we enjoy. Admittedly, it is extremely difficult to figure out how we could know what the correct ontology is, given this second constraint. Perhaps we can't. But, nonetheless, there are mind-independent facts about which ontology is correct, and we can speculate about which ontology is the correct one.

Third, the ontological scheme that I favor contains the following categories. One category is *spacetime region*. I endorse robust spacetime realism, according to which regions are not reducible to constructions made out of their actual or possible occupants. So, for example, regions are not propositions, sets, ordered *n*-tuples, relational structures, or possibilities of location. I will freely talk about regions of spacetime in what follows, and I take such talk with complete ontological seriousness. In chapter three, I argue that friends of extended simples should also endorse robust spacetime realism.[3]

Part of my commitment to robust spacetime regions is a commitment to regions that are not simultaneous with regions that are present now. That is, I deny *presentism*, the doctrine that to be is to be present.[4] There is nothing ontologically special about the time that is *now* any more than there is anything special about the place that is *here*. On this supposition, the future is as real as the present, just as Bellingham, Washington is as real as Amherst, Massachusetts. My denial of presentism covers non-present objects as well. If we were to make a complete inventory of all of the things that there are, we would have to include past objects, such as Socrates, and future objects, such as the first fully manned station on Mars, as well as present objects. This position is usually called *Eternalism*.[5]

A second category in the ontological scheme that I favor is *material object*. Material objects are not reducible to spacetime regions. Instead, they are the things that we find located in spacetime regions. Material objects are not reducible to bundles of properties. Instead, they are the things that *have* the properties. Many philosophers have attempted to reduce the category of material object to these other categories.[6] I reject these attempts at reduction.

Some philosophers reject the category *material object* for a different reason. These philosophers hold that the material world is fundamentally a world of *stuff*, not of *things*. One friend of stuff is Michael Jubien, who writes:

> the world does not come *naturally* divided into a definite array of discrete things. Instead, it consists of "stuff" spread more or less unevenly and more or less densely around space-time. … I am taking it as a fundamental ontological doctrine that the raw material of the physical universe is *stuff*, not *things*, and that the organization of (some of this) stuff into things is done by *us*. [Jubien (1993): 1-2].

Jubien claims that a complete description of the physical universe need not employ the concept of a thing. [Jubien (1993): 2]. Andrew Cortens says something similar in his sympathetic description of the stuff ontology:

> According to [the stuff ontology], reality is to be thought of, not as a collection of objects, but rather, as being made up of stuff of various kinds…. On this view, mass terms serve as the best vehicle for representing reality in a perspicuous way. [Stuff ontologists] will resist any attempt to recast "stuff-talk" into standard object idioms. Any attempt to do so, however "elegant" from a purely formal point of view, they will view as being a move away from, rather than toward, greater perspicuity. In view of this, it seems reasonable to say that the stuff-ontologist endorses a picture of reality which excludes objects. [Cortens (1997): 46-47].

I take it that the central doctrine of the stuff ontology is that truths about the properties and relations of things – if there are any such truths – always supervene on the truths about the properties and relations had by various stuffs. If we wish to assert these truths in a maximally perspicuous way, we should use sentences employing mass terms, not count nouns. In a similar vein, Theodore Sider writes:

> It is important to be clear on how radical this view must be, if it is to be a genuine alternative to a thing-ontology. Some philosophers talk as if they defend a stuff-ontology, when they really just believe in things in stuff's clothing: 'The world consists of quantities of stuff; we can decide to interpret thing-quantifiers as ranging over any of the quantities of stuff we choose. One could use thing-quantifiers to range only over small bits of stuff, in which case the nihilist is right. Or one could use the thing-quantifiers to range over *all* the quantities of stuff, in which case there exists scattered objects.' In fact, this view assumes that the world is a world of things: *quantities* of stuff. … A genuine no-conflict stuff ontologist must claim that a truly fundamental description of the world must completely eschew a thing-language. This requires completely eschewing the usual quantifiers and variables — the backbone of contemporary logic. … A whole new language must be developed. Somehow, 'quantifiers' over stuff must be introduced without slipping into talk of things; somehow language must be invented to express all the facts about the world we take there to be, while not slipping into thing-language in disguise. [Sider (2001): xvii-xviii].

I reject the stuff ontologist's attempts to eliminate things or reduce talk about things to talk about stuff. In fact, I assume something stronger. The truths about the properties and relations stuffs bear – if there are any such truths – supervene on more fundamental truths about the properties and relations had by things. This is my fourth assumption: the world is a world of things, not stuff. (And, moreover, every world is a world of things, not stuff.)

This doesn't mean that we must eschew mass terms. That would be an entirely inappropriate response to the claim that the world is a world of things. We are still allowed to say, "Some water is wet" and "More mashed potatoes is always better than less." But the truth-values of these sentences are determined by facts about things. Specifically, that some portions of water are wet suffices to ensure the truth of "Some water is wet"; likewise, the fact that it is always better to receive a larger portion of mashed potatoes than a smaller portion entails the proposition expressed by "More mashed potatoes is always better than less."

Suppose that the properties and relations instantiated by mereologically complex objects supervene on the properties and relations instantiated by mereological simples. That is, suppose that, once we fixed the properties and relations of all of the material simples, we have fixed the properties of and relations of every complex object. If this is the case, and the world is a world of things, then there is nothing else that the properties and relations of the simples supervene on. There is no "fundamental stuff" that (i) "constitutes" or "makes up" these simples, and (ii) is such that the properties and relations of the simple objects supervenes on the properties and relations of this stuff. This is one metaphysical consequence of the doctrine that the world is a world of things.

So the category *material object* is not to be replaced by the categories *region of spacetime*, *property*, or even *stuff*. It is a fundamental category.

The next set of presuppositions I will discuss concern identity. I assume that there is a relation of classical identity. Identity is not irreducibly relative to a sortal.[7] Nor is identity irreducibly temporally relative.[8] On the contrary, sentences of the form "*x* is identical with *y*" are well formed and require no additional context in order to express a determinate proposition. Sentences of the form "*x* is identical with *y*," if true, are true at all times.

Moreover, the predicate "is identical with" is neither vague nor ambiguous. That is, any sentence of the form "*x* is identical with *y*" in which the singular terms substituted for the variables are neither vague nor ambiguous is a sentence that is determinately true or determinately false and contains no semantic ambiguity. Finally, the predicate "is identical with" is not category-restricted. That is, when we say of two regions of spacetime that they are identical, or of two material objects that they are identical, or of two properties that they are identical, we assert in each case that the same relation is instantiated. Entities of all kinds are identical with themselves in exactly the same way.

The third set of presuppositions I will discuss concern *parthood*. I assume that there is exactly one fundamental parthood relation that material objects can bear to each other. It is true that objects can have all sorts of parts. For example, objects can have spatially connected parts, causally integrated parts, functional parts, immediate parts, etc. And, for each kind of part, there is a corresponding parthood relation, e.g., *x* is a spatially connected part of *y*, *x* is a causally integrated part of *y*, *x* is a functional part of *y*, *x* is an immediate part of *y*. But none of these parthood relations is fundamental.

Each of them is definable in terms of the fundamental notion of parthood and other concepts. For example, we can define these relations as follows:

> x is a *spatially connected part of* y =df. x is a part of y and each of x's parts is connected to some other part of x.
>
> x is a *causally integrated part of* y =df. x is a part of y and each of x's parts is causally related to every other part of x.
>
> x is *functional part of* y =df. x is a part of y and x plays some functional role in the production of some state of y.
>
> x is an *immediate proper part of* y =df. x is a proper part of y and there is no other proper part of y, z, such that x is a proper part of z.

Each of these definitions presupposes the basic notion of a part *simpliciter*. I assume that there is exactly one such basic notion of parthood that applies to material objects.

Several philosophers have denied this presupposition. Chapter one contains an examination of two attempts to argue against this presupposition. I argue that both attempts fail. A lot rides on this presupposition. In chapter two, I discuss the Simple Question, which asks, "Under what circumstances does a material object have no proper parts?" If there is more than one fundamental parthood relation that material objects can bear to each other, then presumably there is more than one way in which an object can be a simple. An object could fail to have one kind of proper part but perhaps have proper parts of another kind. If this could occur, then we really need to ask a variety of "simple questions."

This is not to say that the parthood relation that material objects bear to each other is the same parthood relation that objects of other ontological categories bear to each other. Whether this is the case will be examined in chapter one. I do not presuppose that it is the case; nor do I presuppose that it is not.

I assume that the mereological structure of an object is a mind-independent feature of that object. It is not up to us whether an object is a simple or a composite object. If x is a part of y, then this is a fact about x and y that is metaphysically independent of our hopes, dreams, desires, conventions, language, thought, or form of life.

Some philosophers have denied this assumption. On my way of interpreting him, Kant was one such philosopher. Let us say that P is a *mind-independent* property or relation just in case it is possible that P is instantiated and there are no human persons. According to my interpretation, transcendental idealism is the view that we have no knowledge of the mind-independent properties of things and that our ignorance of the mind-independent properties of things is in some way related to our ability to have *synthetic a priori* knowledge of these things.[9] Since everyone should grant that we do know that some objects have parts – for example, I know that I have a left arm as a part – then, given transcendental idealism, it follows that the relation *x is a part of y* is mind-dependent.[10]

Kant's view that parthood is mind-dependent plays a central role in his attempt at providing a solution of the *second antinomy*.[11] According to Kant, if parthood is a mind-independent relation, then a contradiction must be true. Specifically, Kant argues that if parthood is mind-independent, then the physical universe both does and does not decompose without remainder into mereological atoms. Kant's argument for this claim is interesting and complex. I respond to it elsewhere.[12] Here, I simply assume that it fails.

So I assume that there is always a fact of the matter whether one object is a part of another. A related assumption is that there is also a fact of the matter about what this parthood relation is like. The endurantist typically holds that the fundamental parthood relation that material objects bear to each other is a three-place relation, *x is a part of y at t*. The perdurandist denies this and instead holds that the fundamental parthood relation defined on material objects is a two-place relation, *x is a part of y*. I assume that there is a mind-independent fact of the matter about who is right in this debate.

My fourth set of assumptions concern the nature of predication. I reject so-called *adverbalist* theories of temporal predication. Adverbalist theories of predication are almost always offered as a response to the *problem of temporary intrinsics*. Many philosophers have argued from the conjunction of eternalism and the claim that objects persist through time and undergo change to the conclusion that objects have temporal parts.[13] Suppose that Bill is square Monday night and circular Tuesday morning. On the assumption that shape properties are intrinsic properties – an assumption I challenge in chapter three but provisionally accept here in order to faithfully represent the standard argument from temporally intrinsics – Bill must have undergone a change in his intrinsic properties.

Since eternalism is true, Monday night is just as real as Tuesday Morning, and, more importantly, so are the facts about what occurs on these days. So how Bill is on Tuesday Morning (when Tuesday Morning is present) is not to be identified with how Bill is *simpliciter*. If a predicate *F* stands for an intrinsic property, then any substitution-instance of the schema *Fx* with a non-empty name yields a semantically complete sentence. Since shape properties are intrinsic properties, straightforward ascriptions of these properties to Bill are semantically complete.

But then it seems that we should say that Bill is both circular and square, which is impossible. What to do?

The *relationalist* responds that shape properties are not intrinsic properties but are instead relations to times. Strictly speaking, to say that Bill is circular is either to say that Bill is circular *now* or at some other time supplied by the context of utterance, or it is to say nothing at all. To have a shape is to bear the *is shaped at* relation to some time. The *perdurantist* claims that the things that have these intrinsic properties are ultimately not Bill, but temporal parts of Bill. Bill is square on Monday because he has a temporal part that exists at Monday and is square.

Allegedly, the adverbalist theory is a different response to the problem of temporary intrinsics than both the relationalist and the perdurantist solution. However, it is not clear in what respects the *metaphysics* of the adverbalist solution differs from the metaphysics of the relationalist solution.

As I understand adverbalism, the difference is that the relationalist accepts, while the adverbalist rejects, a view I call the *Doctrine of Timeless Predication.* I will begin by explicitly stating an assumption commonly made by both the relationalist and the adverbalist alike, which I call the *Doctrine of Tenseless Quantification* (DTQ). According to DTQ, serious existential claims have no temporal import; tenseless quantifiers, the use of which is free from the assumption that the members of the domain of quantification are either located in the present or temporally located at all, are the quantifiers to be used when providing a putatively complete ontology. Serious quantification, the kind of quantification that metaphysicians do and should employ when stating their preferred theories of the structure and content of the actual world, is tenseless quantification. Given DTQ, it makes sense to speak of objects that exist but do not presently exist, or even of objects that exist but do not exist in time.[14] Moreover, tenseless quantifiers are more basic than their tensed counterparts. According to DTQ, any proposition expressed by a sentence that employs a tensed quantifier is necessarily equivalent to some proposition expressible by a sentence that does not employ a tensed quantifier. DTQ holds that the truth-makers of tensed claims are supervenient upon the truth-makers of tenseless claims.[15]

In ordinary language, verbs almost invariably are tensed when they are employed; the word 'exists' is, unfortunately, no exception. Frequently, in ordinary contexts, when we make existential claims, we make them using tensed quantifiers. For example, when I say "there is nutritional yeast in the fridge," it is reasonable to interpret my claim as meaning that there is nutritional yeast in the fridge *now*. We also make past- and future-tensed existential claims, e.g., "there was nutritional yeast in the fridge yesterday" and "there will be rain tomorrow." However, there are some semi-ordinary contexts (i.e., contexts outside the philosophy room) in which it is not implausible to claim that tenseless quantifiers are being employed. For example, the quantifiers employed by mathematicians when conducting their business are plausibly construed as tenseless quantifiers. Similarly, when a physicist claims that some portions of spacetime have more curvature than others, the quantifier she is employing is a tenseless quantifier that ranges over the entire spacetime manifold.

There are properties and objects that have the properties. What is the nature of this *having*? Every perdurantist, and every endurantist who accepts the relationalist solution, takes *the* fundamental instantiation relation between an object and its intrinsic properties to be a two-place relation: *x exemplifies F* simpliciter.[16] I call this view the *Doctrine of Timeless Predication* (DTP). According to DTP, just as serious existential claims have no temporal import, serious predication has no temporal import; not only are the existential claims concerning what properties exist stripped of any temporal implications, so too are the claims concerning what properties are instantiated by what objects. According to DTP, serious claims concerning instantiation are *timeless*.

For ease of exposition, let us assume that the number two is an atemporal entity: it literally does not occupy time, just as it literally does not occupy space. Still, we can claim truly that the number two has certain properties, such as the property of *being prime*. A certain relation obtains between the number two and the property of *being prime*. This relation is the *relation of instantiation*, or more simply, the *having relation*. This is the relation that is represented by the 'is' in the sentence, 'the number two is prime.' I will call this usage of the copula *timeless predication*.

This is not to say that, according to DTP, we cannot make claims using tensed or time-indexed copulas, for it is obvious that we frequently do. However, in these situations, any proposition that we express with a sentence that employs a tensed or time-indexed copula is necessarily equivalent to a proposition expressible by a sentence that does not employ a tensed or time-indexed copula.

The adverbalist avoids the problem of temporary intrinsics by rejecting DTP. What does denying DTP involve? One way to be an adverbalist is to claim that the instantiation relation that links objects to their intrinsic properties is actually a three-place relation between an object, a property, and a time. To say that an object has a property P is shorthand for saying that the instantiation links the object and the property to some time *t*, where the value of *t* is fixed by the context of utterance. A problem with this strategy is that there are entities that are not temporally located but nonetheless have properties. Consider the number two. It has the property of being prime. But there is no time at which it has this property. It is not that the number two has the property at *every* time; the number two simply *has* the property.

Perhaps a better way to implement the adverbalist strategy is to hold that there are many distinct instantiation relations. There is no single relation of instantiation; there is more than one way in which an object can have a property. Some objects, such as enduring objects, have their properties in a temporally relative kind of way; other entities, such as numbers, have their properties in an atemporal way. Both of these kinds of instantiation relation will need to be taken as irreducible, since it is clear that the adverbalist cannot analyze talk of instantiation-at-a-time in terms of 'just plain instantiation', parthood and location. So, on this view, for each time *t*, there is a relation *instantiates-at-t*.[17] Roughly speaking, this involves embracing a plurality of equally legitimate copulas; there is more than one way of tying an intrinsic property to an object.

My main complaint with this view is that I do not understand it. I simply cannot grasp more than one instantiation relation. As I see things, there are entities of various kinds, such as material objects, spatiotemporal regions, properties, sets, propositions, etc. Each of these can have properties and stand in relations. There is one metaphysically basic linking relation between objects and their properties: instantiation. An object either has a property, or it does not. Instantiation, unlike ice cream, does not come in different flavors.

A third way of cashing out the metaphysics of adverbalism appeals to *states of affairs*. States of affairs (henceforth: SOAs), understood robustly, are complexes somehow made up of objects and their properties. If an object has an intrinsic property, then, according to the friend of SOAs, there is an entity, an SOA, that is in some way composed of this object and this property.[18] Conversely, SOAs exist only if their constituent objects and properties exist and the objects instantiate the properties.

According to this third way of dealing with the problem of temporary intrinsics, sentences of the form '*x* is *F* at *t*' in which *F* is an intrinsic property assert that a state of affairs in which *x* is *F* exists at *t*. As E.J. Lowe puts it in his discussion of this variant of adverbalism:

> *a*'s having a bent shape *obtains at t* while *a*'s having a straight shape *obtains at t'*. ... a thing's *being shaped* itself stands in relation to times, not that a thing's being shaped is partly a matter of *that thing's* standing in relations to times. [Lowe (1988): 75].

In order to get this version off of the ground, we need states of affairs. But states of affairs are troublesome entities. I believe that we have good reason to do without them.[19] Accordingly, I reject this version of adverbalism as well.

Let me summarize the picture that I have sketched: the material world is a world of things that occupy certain regions of spacetime. Both the things and the regions they occupy enjoy determinate, non-sortal relative, and non-temporally relative identity with themselves. Some of these things are parts of other things, and there is always a mind-independent non-conventional fact of the matter whether this is the case. There is only one fundamental parthood relation that material things bear to each other. Things have properties and stand in various relations to one another, but there is only one way in which a thing can have properties or stand in relations, namely by instantiating them.

This metaphysical picture has many controversial elements. But it is a plausible and commonsensical picture of the nature of the physical world. It is a reasonable starting point from which to begin an investigation into the natures of simples and gunk.

Notes

[1] The second clause is necessary if we allow for composite objects that are composed of objects from different ontological categories. If we restrict composition in such a way that prevents these objects from being generated, we do not need the second clause.

[2] Note that OC4 follows from OC1-OC3.

[3] For a detailed defense of substantivalism, see Nerlich (1994).

[4] On presentism, see Sider (2001) and Zimmerman (1998).

[5] For a more adequate statement of Eternalism, see Sider (2001): 11-12.

[6] For an earlier attempt at such a reduction, see McDaniel (2001). For worries about these strategies, see Hawthorne (2002).

[7] For a defense of this kind of relative identity, see Geach (1980).

[8] For a defense of this view, see Gallois (1998).

[9] See McDaniel (unpublished a).

[10] Compositional nihilists – those philosophers who hold that everything is a mereological simple – will of course deny the claim that I have proper parts. But although they will deny this claim, they shouldn't.

[11] See Kant (1998): 476-483.

[12] See McDaniel (unpublished b).

[13] See Lewis (1986a): 202-205, 210, Lewis (2002), and Sider (2000).

[14] However, DTQ does not imply that there are such objects. So it is possible for the presentist to accept DTQ. On this issue, see Markosian (1994).

[15] This ontological thesis should be distinguished from the linguistic thesis that tensed claims can be paraphrased without loss of meaning in tenseless terms.

[16] A fuller discussion of perdurantism can be found in chapter one.

[17] The advocate of this strategy should probably introduce polyadic instantiation-at-t relations as well, since enduring objects can, I assume, stand in relations to other enduring objects at various times as well as have-at-a-time various intrinsic properties. Alternatively, the advocate of this strategy could embrace a multigrade instantiation-at-a-time relation.

[18] For defenses of states of affairs, see Armstrong (1997). Mellor embraces this strategy in Mellor (1998).

[19] For worries about states of affairs, see Lewis (2002) and Lewis (1986b).

CHAPTER 1

A DEFENSE OF COMPOSITIONAL MONISM

1.1 Introduction

An object is a *simple* if and only if it has no proper parts. An object is *atomless gunk* or *gunky* if and only if every proper part of that object itself has a proper part. An object is *partially gunky* just in case it has some gunky parts and some simple parts. The concepts of a simple and a gunky object both presuppose the concept of *parthood.*[1]

Compositional monism is the view that there is exactly one fundamental parthood relation. According to the compositional monist, the concept of parthood is *univocal.* The *compositional pluralist* disagrees. One kind of compositional pluralism holds that there are different notions of parthood, each of which is defined on distinct ontological categories. Let us call this kind of compositional pluralism *categorical pluralism.* A more radical kind of compositional pluralism holds that there is more than one fundamental parthood relation defined on the category of material objects. Let us call this kind of pluralism *radical pluralism.*

There are also several ways to be a compositional monist. The debate between advocates of the different versions of compositional monism turns on the issue of the scope of the parthood relation. One view – *universalist compositional monism* – holds that the fundamental parthood relation is defined on every ontological category. According to this view, the parthood relation enjoys universal applicability. A view opposed to universalist compositional monism is *restrictivist compositional monism,* according to which the fundamental parthood relation is defined only for material objects, events, and regions of spacetime. The fundamental parthood relation does not enjoy universal applicability on this view.

The question of compositional pluralism is important for the following reasons. First, many philosophers are attracted to the thesis that parthood is strongly analogous to identity. A radical version of this view holds that composition *is* identity. Both varieties of compositional pluralism threaten the moderate and radical versions of the view that composition is identity.

Second, there is reason to think that many important philosophical concepts can be analyzed partly by appealing to mereological concepts. For example, consider David Lewis's analysis of *intrinsic property*: a property is intrinsic just in case it never differs between duplicates; two things are duplicates just in case there is a 1-1 correspondence between their *parts* that preserves perfectly natural properties and relations. [Lewis (1986a): 61-62]. This analysis of intrinsic property appeals to the notion of *part*. However, the analysis attempts to be fully general, since entities of all ontological categories can have intrinsic properties. However, if compositional pluralism is true, then whether an analysis of this sort can be fully general must be questioned.

Third, some metaphysicians endorse a metaphysic according to which some material objects *constitute* other material objects. According to this metaphysic, the golden statue is not identical with the lump of gold with which it shares its location. Instead, the lump of gold *constitutes* the statue. Advocates of constitution typically explicate the notion of constitution partly by appealing to the notion of parthood. But if there is more than one fundamental parthood relation defined on material objects, the possibility arises that one of these parthood relations is the one in which the notion of constitution should be explicated.

Fourth, one of the questions concerning the metaphysics of material objects that has occupied metaphysician's attention is the *special composition question*, which asks under what circumstances some objects compose a whole. If there is more than one fundamental parthood relation defined on the category of material objects, then strictly speaking there is more than one special composition question. And if this is the case, there is no guarantee that the answers to these questions are extensionally equivalent.

Finally, one of the questions addressed in this dissertation is the *simple question*, which asks under what circumstances an object fails to have proper parts. If there is more than one fundamental parthood relation defined on the category of material objects, then strictly speaking there is more than one simple question. And, as before, there is no guarantee that the objects that are simple with respect to one parthood relation are also simple with respect to a different parthood relation.

I note that the last three worries are primarily worries for the radical pluralist. It is not obvious that the categorical pluralist faces those worries. Accordingly, I will focus (for the most part) on radical pluralism. In what follows, I attempt to clarify the questions of whether parthood is univocal and universal. I then critically examine several arguments for compositional pluralism. I argue that the reasons discussed for accepting compositional pluralism fail.

1.2 Is Parthood Univocal?

As I noted in the introduction, I believe in ontological categories, that is, I believe that there are fundamental kinds in the world. Perhaps the common-sense ontological scheme is composed of the following categories:

(1) material objects

(2) times

(3) regions of space

(4) events

(5) properties and relations

(6) possibilities

One fundamental project of metaphysics is ontology, which is the attempt to discover a complete and correct inventory of ontological categories. Another fundamental project of metaphysics is to provide the principles that tell us under what circumstances an element of an ontological category is *simple* or *complex*, i.e., under what circumstances it is appropriate to attribute part-whole structure to a particular entity. It is important to note that the concept of part-whole structure does not appear to apply only to material objects like tables and chairs, for each of the following attributions of part/whole structure makes perfect sense:

(1) The first measure is a part of the song.

(2) 12:30 PM is a part of the interval ranging from 12:00 PM to 1:00 PM.

(3) This part of space is curved.

(4) The third inning was the most boring part of the baseball game.

(5) The weakest part of his argument is where he confuses types and tokens.

(6) Part of what he did when he killed the butler was hit him with a candlestick.

(1) ascribes part/whole structure to abstract types; (2) ascribes part/whole structure to intervals of time; (3) ascribes part/whole structure to regions of space; (4) ascribes part/whole structure to events; (5) ascribes part/whole structure to arguments; and (6) ascribes part/whole structure to actions. Each of these is perfectly intelligible; each of these might be true.[2]

However, we should not infer from the intelligibility of (1)-(6) that *universalist compositional monism* is true. Recall that universalist compositional monism is the view that (i) there is exactly one fundamental part-whole relation and (ii) this relation applies to elements of every ontological category. According to the universalist compositional monist, parthood is importantly similar in this respect to the relation of identity. Just as there is only one fundamental identity relation that applies to any entity regardless of what ontological category it belongs to, there is only one fundamental parthood relation.

The *mereologist*, i.e., the person who believes that the axioms of standard mereology adequately characterise *the* topic-neutral part-whole relation, is a compositional monist.[3] According to the mereologist, there is exactly one fundamental parthood relation and one way of generating complex entities out of simple ones, namely mereological fusion.

The compositional *pluralist* disagrees. According to the compositional pluralist, just as there is more than one ontological category, there is more than one fundamental irreducible parthood relation. There are, of course, many forms of compositional pluralism. One way of being a compositional pluralist is to claim that each ontological category has its own parthood relation. According to this way of being a compositional pluralist, the relation of part to whole that obtains between, e.g., regions of space is not the same relation as the relation of part to whole that obtains between material objects. I called this form of compositional pluralism *categorical pluralism* in the previous section.

According to categorical pluralism, it makes no sense to say that there is a whole composed of objects from distinct ontological categories, since there is no part-whole relation that links objects from different categories. So, for example, there is no object made out of my car and the region of space that it exactly occupies, contrary to the claims of the mereologist.[4] Given categorical pluralism, the following principle governs ontological categories:

Strong Exhaustivity: Every object belongs to exactly one ontological category.

Moreover, conditions (OC3) and (OC4) become completely trivial, since each parthood relation has a restricted domain.

Categorical pluralism is in tension with the doctrine that there are states of affairs that are "unmereologically composed" of objects and properties, where these entities belong to distinct ontological kinds.[5] According to this doctrine, objects and properties can fuse into a distinct kind of whole, a state of affairs. A state of affairs literally has these entities as some kind of constituent. As I see things, there are three reasonable responses to this worry available to the advocate of categorical pluralism. The first response is to give up states of affairs. This is the response that I favour, as I indicated in the Introduction.[6] The second response is to give up the claim that states of affairs are unmereologically composed of objects and properties, and instead merely say that, e.g., necessarily, the state of affairs that a is F exists if and only if a is F. The third response is to allow that there is a distinct kind of composition that can unite members of distinct ontological kinds but still have some categorically restricted composition relations.

Similarly, categorical pluralism is in tension with the claim that *sets* or *classes* are wholes that are made of their members. According to this view, class formation is kind of composition. Since, for example, there are classes that contain regions of spacetime, material objects, and propositions, on this view, there are wholes made out of regions of spacetime, material objects, and propositions. In this case, the best response for the categorical pluralist is not to deny that classes exist, but instead to deny that class formation is a kind of composition. Membership is not a parthood relation.

One of the challenges facing compositional pluralists is to provide principles that determine when a relation is a fundamental parthood relation.[7] In other words, the compositional pluralist must provide a way of filling in the following schema:

> *R* is a fundamental parthood relation defined on ontological category *C* if and only if ______.

This strikes me as being a very difficult project. It is clear that there are necessary conditions on being a parthood relation. For example, no relation deserves to be called a (fundamental) parthood relation unless it is reflexive, transitive, and non-symmetrical.[8] (One could even say that every parthood relation obeys the axioms of classical mereology when the quantifiers in those axioms are restricted to each respective ontological category.) However, these structural conditions are clearly not sufficient. What other conditions are there?

In a recent paper in which he defends the claim that composition is strongly analogous to identity, Theodore Sider discusses two other salient features of the concept of parthood. [Sider (unpublished): 3, 9]. First, there is a necessary connection between the intrinsic properties of a part of an object and the intrinsic properties of the object. Suppose that *x* is a part of *y* and that *x* has intrinsic property F. It follows from this supposition that *y* has an intrinsic property, specifically, having a part that has F. And in general the intrinsic properties of an object's parts partially fix the intrinsic nature of the whole that they compose. We can extract a necessary condition from these remarks: a relation *R* is a parthood relation only if (i) if *x* bears *R* to *y* and *x* has an intrinsic property *F*, then *y* has the intrinsic property *bearing R to something that is an F* and (ii) the intrinsic properties of *y* are partially fixed by the intrinsic properties of those objects to which *y* bears *R*.

A similar constraint is that any parthood relation should be preserved by intrinsic duplication. If *R* is a parthood relation, and *x* bears *R* to *y*, then for any *z*, if *z* is an intrinsic duplicate of *y*, then there is some *w* such that *w* is an intrinsic duplicate of *x* and *w* bears *R* to *z*.

A second salient feature that Sider discusses is that wholes seem to inherit their spatial locations from their parts. If the *xs* compose *y*, and the *xs* are collectively located in spacetime region *R*, then *y* exactly occupies *R*. [Sider (unpublished): 3, 10]. Of course this second salient feature has no clear application to other ontological categories. For example, regions of spacetime do not have locations; they *are* locations. More pressing, it is not obvious that classes have spatial location. I am inclined to think they don't. So, if classes have parts, it is trivially true that classes inherit their locations from their parts. But it is also trivially true that a part of a class inherits its location from the whole it is a part of. In neither case do the entities have locations to inherit.[9]

Mereological essentialism is the doctrine that every whole has its parts essentially. If mereological essentialism is true, then we have another constraint that must be satisfied in order for a relation to count as a parthood relation: R is a parthood relation only if for all x, if x bears R to y, then, necessarily, if x exists, then x bears R to y. Mereological essentialism seems supported by the claim that composition is identity. If the *xs* that compose y really *are* y, then, just as y is necessarily identical to y, y is necessarily composed of the *xs*. [Merricks (1999)]. However, many people resist mereological essentialism. It seems absurd. Perhaps this shows that the doctrine of composition as identity is also problematic.[10]

Third, no relation is a parthood relation unless it is existence entailing. That is, if x bears R to y, then both x and y exist.

It is not clear to me whether these constraints are sufficient to determine whether a particular relation counts as a parthood relation.

Arguments for Radical Pluralism

Some philosophers have claimed that there are multiple fundamental parthood relations that are defined on the category *material object*. I called this view *radical pluralism*. Radical pluralism seems to me to be a much less plausible view than categorical pluralism. In fact, one of my presuppositions is that this kind of compositional pluralism is false. Nevertheless, it will be worthwhile to examine whether there are reasons to abandon this presupposition. I will argue that there are not. I will now discuss two arguments for this kind of compositional pluralism, one due Charles Krecz and the other due to Ariel Meirav.

In a paper titled "Parts and Pieces," Charles Krecz defends a version of compositional pluralism. [Krecz (1986)]. The version of compositional pluralism he defends has the following interesting features. First, Krecz's version of compositional pluralism (henceforth KCP) implies that there are two distinct part-whole relations that material objects can bear to one another. Second, not only do these two kinds of parthood relation apply to objects of the same category, they apply objects of other ontological categories as well.[11] I ignore this second feature of his view in what follows.

In his paper, Krecz argues that (1) the relation "x is a part of y" and the relation "x is a piece of y" are distinct relations, (2) the distinction between these two relations is non-arbitrary, and (3) both relations generate fundamental ways of dividing up material objects into components. Although Krecz does not claim that both relations are "parthood" relations, it is fair to characterize his view as a kind of compositional pluralism. Krecz begins his paper with the following slogan: parts are not pieces.

In order to present Krecz's claims and my responses to them in a neutral way, we will need to be careful with our terminology. Presumably, Krecz is willing to grant that both parts and pieces are *components* of objects, since, in some sense, both kinds of things compose wholes. Once you have all the pieces and the interrelations to each other, you have the whole object. Likewise, once you have all of the parts of the object and their interrelations to each other, you have the whole object. Objects are *made up* of their parts and they are *made up* of their pieces. But, according to Krecz, the relation between pieces of a whole to the whole and parts of a whole to the whole are fundamentally different.

Accordingly, let us employ the word "component" instead of "part" in those contexts in which we wish to remain neutral with respect to KCP. We can now say that, according to Krecz, objects have two different kinds of components, and there are two fundamentally different ways of generating wholes out of material objects. This is why KCP is a kind of compositional pluralism. (In what follows, when I say "component," I mean "proper component," i.e., a component not identical with the whole.)

Krecz denies that the word "part" as it is used in ordinary English is properly applied to every component of material objects. Some components of material objects are not *parts* of the object but are instead *pieces* of the object. According to Krecz, *parts* of objects have the following features that *pieces* of objects lack:

(1) Parts of objects are "non-arbitrary"; pieces of objects are arbitrary.[12]

(2) Parts of objects are not "indifferent with respect to remainder"; pieces of objects are indifferent.

(3) Parts are always parts of "unified wholes" and are never parts of "mere heaps". Pieces can be pieces of unified holes, but can also pieces of mere heaps.

(4) The phrase "x is a part of y" is semantically incomplete. The proper analysis of this phrase is "x bears R to A, B, C, and so on, and thereby x is a part of y." "x is a piece of y" is semantically complete.

(It is not entirely clear if Krecz intends (1)-(4) to stand for completely distinct criteria.) Krecz also claims that the part/piece distinction is relevant to understanding "coming-to-being" and "passing away," and can shed light on the ontological schemes of our philosophical predecessors. [Krecz (1986): 397-400]. I will ignore these contentions and focus on (1) – (4).

In defense of (1), Krecz writes:

> There is something arbitrary about a piece of a whole, something nonarbitrary about a part of it. This is made evident upon considering the ways in which a whole may be divided or thought of as divided. To obtain one sort of division, one may start nearly anywhere; *the locus of the cut* is arbitrary. A piece of a pie is such regardless of the original cut or the locus from which it is taken. [Krecz (1986): 382.]
>
> On the other hand, the division of parts in a whole is neither arbitrary with regard to cut, nor indifferent with regard to remainder. The cut of a part in a whole is *locus-specific* and therefore non-arbitrary. Cut in the wrong place and you have failed to distinguish the part. Instead, you will end up with a piece. [Krecz (1986): 383.]

Consider a bicycle. It has many easily identifiable parts. For example, the parts of the bicycle include its tires, its spokes, its chain, its handlebar, etc. Each of these parts is reasonably well demarcated. Moreover, each of these parts serves a specific function such that, if that function were not served well, then the bicycle either would not function as well or would not function at all.

The pieces of the bicycle are not like this. They are arbitrary, undetached chunks of the bicycle. We do not typically have names for them for we do not usually have occasion to refer to them. But we can if we like. Some examples of pieces of the bike include the chunk of metal right below the water-bottle holder, the lump of worn-out rubber near the rim of the front tire, and the bit of plastic in the right toe-clip.

The distinction between arbitrary components and non-arbitrary components does seem to line up with our intuitions about many typical cases. However, there are other cases in which the distinction does not seem to cut any metaphysical ice. Consider a heap of sand, which was randomly formed by desert winds. Consider the left half of this heap of sand. Presumably, Krecz would say this left half is a mere piece of the heap of sand and not a part of it. Let us now consider a second heap of sand, which is intrinsically indiscernible from our first heap. Suppose, however, that this second heap was created by an artist who painstakingly brought the left half of the heap into contact with its right half. The artist has dubbed his creation "The Love Sand Castle" and claims that it represents the obtaining of true love. The left half of the heap represents one of the lovers; the right half of the heap represents the other lover; and the love they feel is represented by the fact that they these two halves are touching.

It seems to me that in the second case it is natural to say that the left half of the heap is a part of the heap and not a mere piece. The left half plays an important representational role in this art object and accordingly is necessary if the art object is to express what the artist intends to express via this work. (Recall that the left half represents one of the lovers; it is the left half that has this representational property, not the concept of the left half.)

However, the two heaps that we have been considering are intrinsic duplicates. So the relation *x is a piece of y* violates one of the constraints on being a fundamental parthood relation. One of the heaps has a part that occupies its left side. The other heap does not have a part there; it instead has a mere piece.

In general, it seems that the arbitrariness of a component is partly determined by what our interests are. Imagine a bronze statue shaped like a man. We think that the patch of bronze in the statue's left shoulder is an arbitrary component. But someone from the tribe of Fargo who holds that the soul resides in the part of the body near the left shoulder might not think that the component of the statue is arbitrary. That component corresponds to an area in the human body that he holds to be highly significant.

In defense of (2), Krecz writes:

> Another mark of a piece is that the status of a piece is retained regardless of what relationships obtain or fail to obtain between that piece and the whole from which it is taken and regardless of what changes take place in the whole. The remainder may be further divided, the remaining slices may be further arranged, taken away, or even destroyed. Yet in such circumstances, the slice of a pie remains what it is. To characterize something as a piece is to allow an unrestricted range of alteration in the whole from which it is taken. [Krecz (1986): 382].
>
> Further, unlike pieces, parts must stand in a certain definite relation to a whole and its other parts, a relation that admits alteration only within restricted parameters. [Krecz (1986): 383].

Krecz's idea seems to be this. Suppose that we say of some *x* that it is a piece of a particular pie *y*. Then we would also say that *x* is a piece of pie. Suppose we remove *x* and place it on a dinner plate. We then proceed to consume the rest of the pie, but leave *x* completely untouched. Afterwards, we would still say that *x* is a piece of pie. Its status as a piece of pie is unchanged and is in fact completely independent of any relation it bears to the pie from which it came. We would even say that the piece of a pie is a piece of the pie from which it came.

On the other hand, we do not have a similar convention governing the word "part." Prior to its division and eventual consumption, the crust is a part of the pie. Suppose we dump the filling of the pie onto a dinner plate, leaving only the crust in the pie pan. We would certainly not say that the crust is now a part of the pie. And we would not say that the crust is a "part of pie". At most, we would say that the crust used to be a part of the pie.

This shows that the relation *x is a piece of y* does not imply that the relata of this relation exist. Something can be a piece of another thing at a time, even if the thing of which it is a piece does not exist at that time. This violates another constraint on being a fundamental parthood relation.

Moreover, these facts about how we use the terms "piece" and "part" in ordinary language seem to be of no metaphysical significance. Although it is true that we would still say of something that is a former piece of a pie that it is a piece of the pie now, I cannot see how this could be considered important. When we say that something is a piece of the pie, we say this because we know where the thing came from. We could, if we liked, coin a similar phrase "x is a part* of (the pie) *y*," where a pair of things satisfies this phrase just in case the first thing used to be a part of the second thing, the second thing is or was a pie, and the first thing still has certain relevant characteristics, such as being visible, edible, etc. The fact that we have not done this shows that we treat the words "part" and "piece" somewhat differently in ordinary English, but it does not show that there is a fundamental metaphysical difference between parts and pieces.

Moreover, once we have coined this phrase, we can see that parts* of the pie are as indifferent to what happens to the wholes that they were formerly parts as pieces of pie are. The crust is a part of the pie; we separate it from the filling, and now it is no longer a part of the pie. But it is a part* of the pie. And moreover, it will remain a part* of the pie regardless of what we do the rest of the pie. So "indifference with respect to what happens to the remainder" does not seem to be a significant metaphysical feature.

In support of (3) and (4), Krecz writes:

> Parts are sensitive to a whole and to other parts in that *they are as one in the whole*. The actual division of the parts in a whole, unlike an actual division into pieces, precludes neither the unity nor the singularity of the whole. In fact, as we shall see, the manner of division of the parts in a

> whole is responsible to a considerable extent for the unity of the whole. Since "being as one" is what ultimately distinguishes the many parts from the many pieces, it is our task to analyze this difficult notion. [Krecz (1986): 386].

> The sentence "*A* is a part of *W*" is *elliptical*. Its proper analysis is "*A* is related to *B*, *C*, and so on, and is thereby part of *W*." [Krecz (1986): 387].

Krecz appears to be saying that the parts of an object are integrated in a way that the pieces of an object are not. In order for a collection of objects to form an "integrated unit," the collection needs to be systematically related in some way. It takes hard work, apparently, to bring about true unity. To be a piece is much easier. A collection of objects can be pieces of some further thing without much work. However, this further thing is a mere heap, and not an integrated whole. Heaps come cheap.

Moreover, all ascriptions of part-whole structure to a pair of objects are semantically incomplete; a semantically complete ascription of part-whole structure to a pair also mentions the relation that the part stands in to other parts *in virtue of which each of them is a part of the whole.* However, sentences of the form "*x* is a piece of *y*" are not semantically incomplete or elliptical. To say that an object is a piece of another is just to say that it is a piece of another. This claim that sentences of the form "x is a part of y" are elliptical strikes me as deeply problematic. I grant that no object can have exactly one component. (Recall that by "component", I mean "proper component.") So no object can have exactly one part. So the claim that *A* is a part of *W* does imply the claim that there is some *y* such that *y* is not *A* and *y* is a part of *W*. But this fact provides no reason to think that the claim "*A* is a part of *W*" is semantically incomplete or elliptical.

Similarly, we could grant that some objects are parts of some whole only if there is some relation *R* such that these objects compose a whole in virtue of the fact that they instantiate *R*. Still, we should not infer from this claim that talk about parthood is semantically incomplete.

Accordingly, let us focus on claim (3). Krecz writes:

> Consider the parts of an ordinary object, say, an apple with its skin, flesh, and core. When the core of an apple is indeed part of it, it receives a determination it would not otherwise have. To be a core it must yield prerogatives. Simply, it goes where the whole apple goes and nowhere else. Were the core to gain new prerogatives and were it able to go elsewhere, it would lose its status as part; to be the part that it is, viz., a core, it must remain inside the apple, enveloped by flesh and skin. But the skin of an apple is part of it as well. To be the part that it is, viz., the skin, it must envelope flesh and core. Further, it can achieve this only because there is flesh and core. Now such claims about the parts of an apple are hardly remarkable. Further, they reveal little of the superb complexity and subtlety of other relations of codetermination which actually obtain between the various parts of an apple. But they do illustrate codetermination directly and simply; the determination of the prerogatives of the core, flesh, and skin of an apple obtains in virtue of the relations between these parts. Such determination is requisite of the apple to be a whole. Similar determination may be attributed to any of the parts of any whole. [Krecz (1986): 387-388].

The idea expressed here seems to be this: when an *x* is a part of an object, it acquires certain relational characteristics. Moreover, the other parts of an object acquire relational properties as well in virtue of *x*'s being a part of the same object. And, unless these objects had these relational properties, the composite object would not be an integrated whole.

The relevant relational properties in the passage Krecz discusses seem to be ones that guarantee that the parts of an object move as a unit. If the skin of an apple and the core of an apple are part of the same apple, then when the apple is moved ten feet, so too are the skin and the core. And, were the skin of the apple not to move when the apple moves, then the skin would cease to be a part of an apple. Finally, if the skin of the apple or the core of the apple were to move independently of each other, then one of them must not be a part of the apple.

Krecz's claims with respect to apples and their parts have a lot of plausibility. But I'm not clear how this helps us draw the distinction between parts and pieces in way that would cut any metaphysical ice. For similar claims with respect to pies and their pieces have equal plausibility. Consider a pie and a large chunk of the pie in the middle. If we remove that chunk of pie from the pie –if they no longer move together as one – then that chunk of pie is no longer a *component* of the pie. It is true that the chunk is still a *piece of pie* – it is even a piece of the pie -- but these facts don't seem relevant. And it is true that the chunk is a piece *that came from the pie*, but again, that fact doesn't seem relevant to establishing that the parts/pieces distinction is metaphysically fundamental. So I have a hard time seeing how (3) supports the claim that the parts/pieces distinction is metaphysically fundamental.

I have addressed each of the distinctions that Krecz alleges underlies the difference in usage of the terms "part" and "piece" in ordinary English and have argued that each of the associated claims about these distinctions is problematic. Let us class these worries aside and now attend to what I take to be the fundamental worry about Krecz's position.

Once we have the concept of a *component* of an object, it seems clear that we should not take the fact that we distinguish between parts and pieces in ordinary English to support compositional pluralism. For, once we have the concept of a component, we can *define* these two notions in terms of the concept of a component and the distinctions that Krecz claims underlies the difference in usage of the terms "part" and "piece." And, if we can give such definitions, then there is no reason to think that the relations *x is a part of y* and *x is a piece of y* are metaphysically basic.

It is easy to see what the definitions should look like, given that we accept (1), (2), and (3):[13]

> *x is a part of y* =df. (1) *x* is a *component* of *y*, (2) *x* is a non-arbitrary component of *y*, (3) *x* is not indifferent with respect to remainder and, (4) *y* is a "unified whole."
>
> *x is a piece of y* =df. (1) *x* is a *component* of *y*, (2) *x* is an arbitrary component of *y*, and (3) *x* is indifferent with respect to remainder.

In fact, we can see that it is possible to think of intermediate kinds of components, which are neither parts nor pieces. Such components might be non-arbitrary components that nevertheless are indifferent with respect to remainder. We could, if we liked, call these components "partlike pieces." Similarly, we can think of possible components that are arbitrary but not indifferent with respect to remainder. We could, if we liked, call these components "piecelike parts." However, our exercise in conceptual generation would not give us any reason to think that there are four *fundamental* part-whole relations defined on the category of material object. So I conclude that Krecz has not provided us with a reason to believe that there are two fundamental part-whole relations defined on this category.

Another advocate of compositional pluralism within the ontological category *material object* is Ariel Meirav, who defends the view in an intriguing paper titled "Non-Unique Composition." [Mierav (2000)]. Mierav's version of compositional pluralism has the following interesting features. First, according to Mierav's view (henceforth: MCP), although there is only one fundamental parthood relation defined on the category *material object*, there are two metaphysically basic *composition relations*. Second, Mierav argues that MCP provides a successful account of how two objects can be composed of exactly the same parts at the same time but nonetheless be non-identical. Clearly, Mierav's view deserves further examination.

Several issues need to be addressed. The first concerns whether it really is possible for two things to be made out of exactly the same parts at the same time. Mierav assumes throughout the paper that this is possible and accordingly accepts that he must explain how it is possible.[14] There is certainly nothing improper about Mierav simply assuming that material objects can be superposed in this fashion, for other philosophers have elsewhere argued that this is possible. Mierav is simply trying to further the research program to which he has sworn allegiance.

However, I do not belong to this research program. I am unmoved by the considerations that lead many to say that the lump of clay is not identical with the statue. I am my body, and you are yours. Since I reject Mierav's starting point, I am not in any position to be moved by his argument for compositional pluralism. Compare my situation with the following: it might be that the best way for the committed theist to solve the problem of evil is for her to endorse a libertarian account of free agency. This fact might imply that the theist has a reason to be a libertarian. But it certainly does not give the atheist a reason to endorse libertarianism.

Let us table this issue. I will grant for the sake of the argument the claim that non-unique composition is possible. Instead, I will argue for the following conditional claim: even if you grant that non-unique composition is possible, you should reject

MCP. I will now present an exposition of MCP. Afterwards, I will present an argument against MCP.

Mierav assumes that there is only one parthood relation, *x is a part of y*. [Mierav (2000):330-331]. Given this, it seems hard to see how there can be a plurality of *composition relations*, for in standard mereology, the multigrade relation *x is composed of the ys* is defined in terms of parthood. The standard procedure for defining *composition* is as follows. First, we define *overlap* and *sum:*

D1: *x* overlaps *y* =df. for some *z*, z is a part of *x* and *z* is a part of *y*.

D2: *y* is the sum of the *xs* =df (i) each of the *xs* is a part of *y* and (ii) for all *z*, *z* overlaps *y* if and only if *z* overlaps one of the *xs*.

Both of these concepts are defined using only logical vocabulary and the concept of parthood. The standard notion of composition can now be introduced:

D3: the *xs* compose *y* =df. *y* is a sum of the *xs*.

Since the concept of composition can be defined in this way, it is hard to see how there can be room for a plurality of fundamental composition relations, given that there is only one fundamental part-whole relation.

Mierav's strategy is to argue that D3 does not capture the intuitive notion of composition. Instead, D3 emerges as a special case of a more general notion of composition. According to Mierav, there are two different species of this more general notion of composition. Mierav claims that the more general notion of composition is captured by the following definition:

D4: the *xs* compose *y* at *t* =df. (i) each of the *xs* is a part of *y* at *t* and (ii) the existence of all of the *xs* and their having the features they do at *t* is a sufficient condition for the existence of *y* at *t*. [Mierav (2000): 332].

Mierav notes that the conjunction of D4 and the following assumption is equivalent to D3:

> A1: *y* is a sum of the *xs* at *t* if and only if (i) each of the xs is a part of y (at t) and (ii) the existence of all of the xs and their having the features they do (at t) is a sufficient condition for the existence of y (at t). [Mierav (2000): 333].

Accordingly, Mierav denies A1. In its place, Mierav recommends:

> A2: If *y* is a sum of the *xs* at *t*, then (i) each of the xs is a part of y (at t) and (ii) the existence of all of the xs and their having the features they do (at t) is a sufficient condition for the existence of y (at t). [Mierav (2000): 333].

Mierav claims that the general notion of composition is captured by D4 and A2. He then introduces two species of composition, each of which falls under this more general notion:

> D5: The *xs* compose$_1$ *y* (at t) =df. (i) the *xs* compose *y* (at t) and (ii) necessarily, for all *u*, (for all t'), if *u* is of the same sort as *y* (at t'), then for any *zs* such that the *zs* compose *u* (at t'), u is a sum of the *zs* (at t').

> D6: The *xs* compose$_2$ *y* (at t) =df. (i) the *xs* compose *y* (at t) and (ii) possibly, for some *u*, (for some t'), *u* is of the same sort as *y* (at t'), and for some *zs*, the *zs* compose *u* (at t'), and *u* is not a sum of the *zs* (at t'). [Mierav (2000): 335].

Next, Mierav notes that the conjunction of D5 and A2 is equivalent to the following:

> A3: the *xs* compose$_1$ *y* (at t) =df. *y* is the sum of the *xs* (at *t*). [Mierav (2000): 336].

Accordingly, the standard definition of composition emerges as a special case of composition given Mierav's account.

Mierav claims that MCP can help answer what he calls the question of non-unique composition, which is:

> What difference between the respective features of the two wholes is consistent with the assumption that they are superposed, that is, composed of precisely the same parts? I shall call this "the question of non-unique composition". [Mierav (2000): 323].

One answer to the question of non-unique composition, which Mierav dismisses right away, is that the superposed objects differ with respect to their temporal or modal properties. Mierav writes:

> The familiar answer tells us that continuants superposed at *t* in the actual world might differ from one another in respect of features current at another time or in another possible world. It is silent, however, on the question whether, and how, such continuants might also differ from one another in respect of features current at t and in the actual world. The latter question, however, is an obvious corollary to the question of non-unique composition, and should be addressed in any account that aims to be satisfactory.
>
> Indeed, someone who upholds the familiar answer is committed to providing an answer to the corollary as well, unless he or she is prepared to assume that distinct continuants can be indiscernible (at times in which they are superposed). This assumption, however, is highly paradoxical. [Mierav (2000): 325].

In other words, differences in the modal or temporal properties of objects must be grounded in the non-modal or non-temporal properties of objects. Mierav argues that when objects are superposed, the non-modal/non-temporal difference between the two superposed objects is the way in which they are composed of their parts.

My main objection to MCP is that D4 does not capture our intuitive conception of composition. There are cases in which composition clearly occurs, but the right-hand side of the biconditional is not satisfied. D4 plays a central role in Mierav's theory, since it is supposed to be a general account of composition, from which composition$_1$ and composition$_2$ emerge as special cases. So, if D4 goes, then MCP goes as well.

Recall D4:

D4: the *xs* compose *y* at *t* =df. (i) each of the *xs* is a part of *y* at *t* and (ii) the existence of all of the *xs* and their having the features they do at *t* is a sufficient condition for the existence of *y* at *t*.[15]

I will present two counter-examples to D4. *First counter-example*: Sally is a human person. Human persons are material objects and hence are made out of fundamental particles. Call the class of fundamental particles that compose Sally on her 16th birthday *the Sally Class*. Sally's 16th birthday occurs on 7-30-2004. So, at 7-30-2004, the elements of the Sally Class compose Sally.

Let us consider another possible world *w* at which each of the elements of the Sally Class exists. However, at 7-30-1988 these elements compose nothing interesting and certainly don't compose a newborn baby. The elements of the Sally Class continue to compose nothing particularly interesting until 7-30-2004. Prior to this date, the particles have been scattered widely apart. But now, due to chance or divine plan, at a precise moment on 7-30-2004, the particles coalesce into the shape of human person who is an intrinsic duplicate of Sally. These particles have the same intrinsic properties and stand in the same spatial and causal relations to each other in *w* as they actually do.

No human being was even remotely near the region where these particles coalesced. An outside observer employing a very powerful telescope would see a pretty much empty area followed by the sudden appearance of a human-shaped thing. But the thing that these particles compose in *w* is *not* Sally. Plausibly, Sally has her origins essentially. At the very least, Sally is not the kind of thing that could come into existence in this way. It is even doubtful whether the thing in *w* is a human being or a person. But presumably Sally is essentially either a human being or a person. So it is possible for some *xs* to compose a *y* at a time and yet for it not be the case that the existence of all of the *xs* and their having the features they do at *t* is a sufficient condition for the existence of *y* at *t*.

Second counter-example: suppose that at *t*, a collection of bricks compose a house. Let's call the class of bricks that compose the house, *the Brick Class*. The house would have existed had it contained one less brick in the chimney. Let us go to a world *w* at which all of the bricks in the Brick Class are arranged in exactly the same way as they actually are, save for a missing brick. Let us call the class of bricks that compose the house at this world, *the Brick Minus Class*. At *w*, the elements of the Brick Minus Class compose the house. But, at the actual world, the elements of the Brick Minus Class do not compose the house, even though all of its members exist and stand in the same relations as they do in *w*. So the existence of all of the bricks in the Brick Minus Class and their having the features they do at *t* is not a sufficient condition for the existence of the house at *t*, even though the bricks do compose the house at *t* at world *w*. We have a second counter-example.

Since D4 is central to Mierav's project, and since D4 is not an adequate analysis of composition, I conclude that Mierav has failed to demonstrate that there are two fundamental kinds of composition.

Persistence and Categorical Pluralism

An interesting argument for a different kind compositional pluralism – categorical pluralism – can be developed based on the claim that objects persist through time by *enduring*. Here, I discuss this argument and attempt to undercut it.

It is uncontroversial that objects persist through time. I believe that I have enjoyed 27 years of life; I hope to enjoy at least twice as many years more. Neither my belief nor my hope would be warranted if objects did not persist through time. The interesting question is *how* objects persist through time.

Here is a rough characterization of the territory; in a moment, I will introduce a more precise account of the positions discussed. *Perdurantists* hold that objects persist through time in the same way that objects extend through space. According to perdurantist, just as an object is extended in space in virtue of having spatial parts, so too is an object extended in time in virtue of having temporal parts. *Endurantists* deny the analogy between persistence through time and extension in space. Endurantists hold that objects persist through space by being *wholly present* at different times. In short, persisting objects enjoy multiple locations in spacetime without having proper parts corresponding to these locations.

Perdurantism and endurantism are contrary positions. But they do not exhaust logical space. I will argue that there are intermediate positions that are available for consideration once we distinguish several questions.[16] Specifically, we should distinguish the question of what parthood relation is defined on material objects from the question of what sort of regions of spacetime material objects can reside in. I address the former question here. Is the fundamental parthood relation defined on material objects a two-place atemporal parthood relation *x is a part of y*? Or is the fundamental parthood relation defined on material objects a three place time-indexed parthood relation *x is part of y at t*? The perdurantist holds that the fundamental parthood relation defined on material objects is an atemporal relation. On the other hand, the endurantist asserts that it is a three-place relation.

The reason the endurantist does this is straightforward. Recall that one of my presuppositions is that *eternalism* is true. Roughly speaking, eternalism is the doctrine that all times (and their contents) are ontologically on a par; past and future times exist in just the same sense as present times exist.[17] The worry is that endurantism – given eternalism – is committed to *mereological constantism.*[18] According to mereological constantism, if an object has a part at one time, then it has that part at every time that the object is present. Suppose that the fundamental part-whole relation is the two-place relation *x is a part of y.*[19] Since this is a non-temporally indexed parthood relation and it is *the* parthood relation, the temporal relativizations on ascription of parts to an object simply drop off. If an object has a part at a time, it has that part *simpliciter.* And, accordingly, we have mereological constantism. Nothing ever changes parts.

Mereological constantism is often viewed as being wildly counter-intuitive. So there is pressure to reject one of the premises in the argument that leads to mereological constantism. There is a wide range of potential targets. But the target that most endurantists aim at is the assumption that the fundamental part-whole relation that applies to material objects is an atemporal part-whole relation. Instead, most endurantists opt for the view that the fundamental part-whole relation that applies to material objects is a temporally indexed part-whole relation: *x is a part of y at t.*[20]

Actually, though, there are good reasons for the endurantist to take the fundamental parthood relation defined on material objects to be a spatiotemporally indexed parthood relation, not merely a temporally indexed parthood relation. That is, instead of taking the fundamental parthood relation defined on material objects to be *x* *is a part of y at t*, the endurantist should take it to be *x is a part of y at R*, where *R* is a region of space-time.[21]

The main reason the endurantist should take the fundamental parthood relation defined on material objects to be indexed to space-time regions and not to times is special relativity.[22] Given special relativity, strictly speaking, there are no such things as times, or at least, there are no things that perfectly match our concept of what it is to be a time.[23] Instead, there are equivalence classes of regions of space-time that may be thought of as times *according to an inertial frame of reference*. Since the three-place relation *x is simultaneous with y relative to frame F* is well-defined, we can say that a time relative to *F* is a maximal class of spacetime points pair-wise simultaneous to each other relative to *F*. Of course, the endurantist could say that the fundamental parthood relation defined on material objects is indexed both to a time and a frame of reference. But these times (and frames of references) are hardly fundamental entities – they are paradigmatic instances of logical constructions – and so it would be strange to index a fundamental relation to entities that are clearly not fundamental constituents of the world. A far more natural move for the three dimensionalist to make is to take the fundamental parthood relation defined on material objects to be spatiotemporally indexed and then analyse the parthood relation *x* is a part of *y* at *t* at frame *F* in terms of it.[24]

Fortunately, we can do this. We begin by taking our primitive parthood relation to be *x* is a part of *y* at *R*, where *R* is a region of spacetime. If we wish, we can restrict the candidate regions to those that are maximally continuous three-dimensional slices of spacetime, i.e., hyper-planes. Three-dimensional slices of spacetime are the sorts of things that enduring objects can be wholly present at, allowing us to adopt the following axiom: x is a part of y at R only if both x and y are wholly present at R. We next introduce the notion of being a time at a reference frame: times at reference frames are fusions of spacetime points such that each point is simultaneous with the others at that reference frame. Finally, we introduce a defined time and frame indexed parthood relation: x is a part of y at t at F if and only if there is an R such that x is a part of y at R and R is t at F.[25]

Note that this sort of definition will also be available for use in spacetimes in which a two-place notion of absolute simultaneity is well defined. As above, the fundamental spatiotemporal entities are spacetime points. However, in these spacetimes we can identify times with maximal fusions of simultaneous spacetimes points, which are simply hyper-planes of simultaneity.

So the endurantist should hold that the fundamental parthood relation defined on material objects is *spatiotemporally* indexed. However, since nothing that follows in this section turns on this complication, I will ignore it for now. The important point is that endurantists have good reason to commit themselves to the claim that the parthood relation defined on material objects is a three-place relation.

I have argued that the endurantist should claim that the fundamental parthood relation defined on material objects is a three-placed relation *x is a part of y at t*. Must the endurantist who takes this route also be a compositional pluralist? There are powerful reasons to say that she must. For the endurantist believes in intervals of times. And it is undeniable that part-whole structure applies to these entities. However, what is deniable – and what ought to be denied – is that the fundamental part-whole relation that is defined on temporal intervals is the relation *x* is a part of *y* at *t*. It seems clear that the fundamental parthood relation defined on temporal intervals is a non-temporally indexed parthood relation, but in case an argument for this is required, consider the following. Suppose that the fundamental parthood relation defined on temporal intervals is *x* is a part of *y* at *t*. At what time is 12:30 a part of the interval beginning at 12:00 and ending at 1:00? Given the principle that an object *x* is part of another object *y* at time *t* only if *x* and *y* are both wholly present at *t*, there is no time at which 12:30 could reasonably be said to be a part of the interval (12:00, 1:00). This is because (i) this interval is not wholly present at 12:30 and (ii) 12:30 is only wholly present at itself. So the advocate of three dimensionalism and Eternalism should not say that the parthood relation defined on times is the temporally indexed parthood relation *x* is a part of *y* at *t*.

So the endurantist should believe that the fundamental parthood relation defined on intervals of times is the non-temporally indexed relation *x is a part of y*. However, in order to avoid mereological constantism, the three dimensionalist should believe that the fundamental parthood relation defined on material objects is the temporally relativized relation *x is a part of y at t*. It should be clear that these two parthood relations are not identical, since their *adicity* differs; *x is a part of y* is a two-place relation, whereas *x is a part of y at t* is a three-place relation. So the endurantist should be a compositional pluralist.

So the endurantist should say that the concept of parthood is not univocal. There are two ontological categories such that the parthood relations defined on those categories are not identical. Endurantists should endorse compositional pluralism.

The Case for "*x* is a part of *y*"

I will now present an argument for the claim that the fundamental parthood relation defined on material objects is a two-place atemporal relation *x is a part of y*. The argument is not terribly original; the bulk of the argument is based on the work of Theodore Sider.

The first premise is that the best way to solve the problems of temporary material coincidence, conventional identity, and vagueness is by appealing to temporal parts. The second premise is that the ontology of temporal parts is acceptable only if the fundamental parthood relation defined on material objects is a two-place atemporal relation *x is a part of y*. Given these two premises, we should believe that the fundamental parthood relation defined on material objects is a two-place atemporal relation *x is a part of y*.

Since Theodore Sider has already provided an extended defense of the first premise – he devotes two chapters of Sider (2001) to this task – I will concentrate on the second premise.

Two preliminary points are in order. First, even the advocate of the claim that the fundamental parthood relation is a three-placed temporally relativized relation can believe in temporal parts. For the doctrine of temporal parts can be stated in terms of this relation in the following way:

> *X* is an *instantaneous temporal part of y at t* =df. (1) *x* exists at, but only at, *t*, (2) *x* is a part of *y* at *t*, and (3) *x* overlaps at *t* everything that is a part of *y* at *t*.
>
> (DTP1): For any object *x* and time *t* such that *x* exists at *t*, *x* has an instantaneous temporal part at *t*. [Sider (2001): 59].

It will be useful to have a slightly stronger version of DTP available as well. Let us introduce the notion of an *extended temporal part*:

> *X* is an *extended temporal part of y* at interval *T* =df. (1) *x* exists at every instant in *T* and at no instant not in *T*, (2) for each *t* in *T*, *x* is a part of *y* at *t*, and *x* overlaps everything that is a part of *y* at *t*.

> (DTP2): For any object *x* and interval *T* such that *x* persists through *T*, *x* has an extended temporal part at *T*.[26]

I note that DTP2 entails DTP1, but that the converse does not hold unless we assume universal fusion of temporal parts, which may be regarded as unintelligible by the endurantist. I will focus on DTP2 in what follows.

Second, if the fundamental parthood relation defined on material objects is the relation *x is a part of y*, we can and should introduce a *defined* temporally-relativized parthood predicate *x is a part of y at t*. The definition is simple, given that there are temporal parts:

> (PatT): *x is a part of y at t* =df. *x* and *y* each exist at *t*, and *x*'s instantaneous temporal part at *t* is a part of *y*'s instantaneous temporal part at *t*. [Sider (2001): 57].

Since the doctrine of temporal parts can be stated using a three-place parthood predicate, the endurantist can believe that objects have temporal parts. And since the perdurantist can understand this three-place parthood predicate, there is no reason for her to balk at this formulation of DTP. (Although, as Sider points out, from the perspective of the perdurantist, this formulation is not maximally perspicuous. See Sider (2001): 57.)

However, although an endurantist can accept temporal parts, doing so requires her to accept the possibility of total mereological coincidence as well. Two material objects suffer from total mereological coincidence given endurantism just in case there is a time or times at which both objects have exactly the same proper parts. More generally, two objects suffer from total mereological coincidence just in case the fundamental parthood relation defined on material objects relates these two non-identical objects to the same collection of parts.

To see this, let us turn to one kind of problem for which temporal parts provide the solution, specifically, the problem of vague persistence. Suppose that it is indeterminate whether Fred persists from t1 to t4. This is because it is indeterminate whether Fred exists at t4, although it is determinate that Fred persists from t1 to t3. The friend of temporal parts diagnoses this situation as a case of semantic indeterminacy. There is an object that determinately persists from t1 to t4. There is another object that determinately persists from t1 to t3. This latter object is an extended temporal part of the former object. In this situation, it is indeterminate whether "Fred" refers to the temporally longer object or the shorter object. It is not indeterminate what things exist.

The friend of endurantism can help herself to this solution. But it requires her to say that, during t1 through t3, there are two non-identical objects that are related via *the* fundamental part-whole relation to the same group of objects.

The perdurantist also helps herself to the temporal parts solution, but without paying the price of genuine coincidence. Since the three-place part-whole relation is a *defined* parthood relation on the perdurantist view, that the perdurantist accepts temporal parts does not imply that she must also accept total mereological coincidence, for the fundamental parthood relation defined on material objects is a two-place relation. And nothing in this application of temporal parts to our problem involves holding that two non-identical objects are related to the same collection of parts via this relation. Since total mereological coincidence is to be avoided, the ontology of temporal parts is acceptable only if the fundamental parthood relation defined on material objects is a two-place atemporal relation *x is a part of y*.[27]

Parthood and Occupation

The typical endurantist says that the fundamental parthood relation is a three-place relation and that objects are wholly present at more than one time. The typical perdurantist responds that the fundamental parthood relation is a two-place relation and that objects are never wholly present at more than one time. Since the typical endurantist (or perdurantist) claims about occupation and parthood are not necessarily equivalent, there is room for other views on the question of how objects persist through time.

In order to address these questions carefully, I need to introduce some technical vocabulary. In what follows, I will assume that the fundamental parthood relation defined on material objects is the atemporal relation *x is a part of y*. Recall that the ontology endorsed in the Introduction contains regions of spacetime and material occupants of those regions. The primitive relation that material objects bear to regions of spacetime is the *occupation* relation. A region occupied by a material object is where that object is located in spacetime. It is where the object is at. The following "axioms of occupation" should help the reader grasp the relevant relation. If an object *x* occupies a region of spacetime *r*, then every part of *x* occupies some part of *r*. Example: I occupy a particular region of spacetime and my hand occupies a subregion of this region. However, if *x* occupies a region of spacetime *r*, it does not follow that *x* occupies a proper subregion of *r*. In fact, this typically will not be the case; instead, in the typical case, a proper part of *x* occupies a proper subregion of *r*. Example: the current temporal part of my desk occupies a three-dimensional subregion of spacetime. It does not occupy the subregion (of that region) that is occupied by the current temporal part of the leg of that desk. If an object occupies two disjoint regions, it does not follow that the object occupies the fusion of these regions. (In such a case, the object enjoys multi-location. Examples of this case are not obvious, but here is a putative one: a universal is instantiated at by an object at *R1* and a different object at *R2*. It is not instantiated by the fusion of these objects. Presumably, then, the universal occupies *R1* and *R2* but does not occupy their union.)

The following definitions will also be helpful:

> *x fills* region *R* =df. Either (i) there is some *R'* such that *R* is a part of *R*' and *x* occupies *R*' or (ii) there is a region *R'* and there are regions, the *rs*, such that *R'* is the fusion of the *rs*, *x* occupies each of the *rs*, and *R* is a part of *R*'.
>
> *x lies within R* =df. There is some region *R'* such that *R'* is a part of *R* and *x* occupies *R*'.
>
> *R* is empty =df. There is no *x* such that *x* fills *R* and there is no *x* such that *x* lies within *R*.
>
> *X exactly occupies R* =df. *x* occupies *R* and no region other than *R*.
>
> *x* is *multi-located* =df. There are regions *R* and *R*' such that (i) *R* is not identical with *R*' and (ii) *x* occupies *R* and *x* occupies *R*'.
>
> *x dominates R* just in case (i) *x* occupies *R*, (ii) it is not the case that *x* occupies some proper sub-region of *R*, and (iii) no proper part of *x* occupies a proper part of *R*.

The typical endurantist endorses one claim about parthood, specifically that parthood is a three-place relation, and two claims about occupation. The second claim made by the typical endurantist is that it is possible for objects to enjoy multi-location.

For example, on the typical endurantist picture, a point-particle persists by successively occupying disjoint regions of spacetime. The third claim is that no object occupies a region of spacetime that is extended in the temporal dimension.

The typical perdurantist endorses a claim about parthood, specifically that it is a two-place relation, and two claims about occupation. The second claim made by the typical perdurantist is that objects do not enjoy multi-location. Every object exactly occupies some region of spacetime. The third claim is that many objects occupy regions of spacetime that are extended in the temporal dimension.

However, there are some points of agreement between the typical endurantist and the typical perdurantist. Suppose a point particle *p* persists from t1 to t2. Call the one-dimensional spatiotemporal region that it persists through *R*. Both the typical endurantist and the typical perdurantist will grant that *p* fills *R*. And both the typical endurantist and the typical perdurantist will grant that *p* does not dominate *R*.

So far then we have the following positions:

Typical Endurantism:

(1) Necessarily, parthood is a three-place relation.

(2) Possibly, some objects enjoy multi-location.

(3) Necessarily, no object occupies a temporally extended region of spacetime.[28]

(4) Necessarily, no object dominates a temporally extended region of spacetime.

Typical Perdurantism:

(5) Necessarily, parthood is a two-place relation.

(6) Necessarily, no object enjoys multi-location.

(7) Some objects occupy temporally extended region of spacetime.

(8) Necessarily, no object dominates a temporally extended region of spacetime.

Typical Endurantism and Typical Perdurantism are contraries. They do not exhaust the possible positions on how objects persist. But it should be clear now that there are many other positions available. As it turns out, I endorse a following position that is inconsistent with both typical endurantism and typical perdurantism.[29] First, like the typical perdurantist, I accept that the fundamental parthood relation defined on material objects is a two-place relation; I argued for this claim in II.5. So I reject (1) but accept (5). Second, like the typical endurantist, I accept that objects can be wholly present at multiple regions of spacetime; I defend this view in chapter 3. On one conception of extended simples – the Parsonian Conception – extended simples are objects that fill an extended region of spacetime via enjoying multi-location.[30] However, although I accept that Parsonian simples are possible, I provide reasons for doubting that they are actual in chapter 3. (The argument in II.5 also provides some reason to think that temporal Parsonian extended simples are not actual.) So I accept (2) but reject (6).

Finally, unlike both the typical endurantist and the typical perdurantist, I am willing to countenance the possibility that all extended regions of spacetime are possibly dominated by material objects. In chapter 3, I argue that spatiotemporally extended simples are possible. On another conception of extended simples, extended simples dominate the regions they occupy. Once you accept that some extended regions of spacetime can be dominated, it is hard to see how you could argue that some extended region of spacetime could not be. So I reject (4) and (8).

I have defended compositional monism from attack. I will now turn to the question of what sort of compositional monism we should adopt. Should we accept that parthood is universal?

1.3 Is Parthood Universal?

A concept is *strongly universal* just in case, necessarily, it applies to everything there is. There are universal concepts. For example, the concept *being self-identical* is universal, since everything is self-identical. Another example of a universal concept is *being such that 2+2=4*. A concept is *weakly universal* just in case there is no ontological category such that the concept applies to no members of that category. We will now investigate whether "has parts" is strongly or weakly universal.

By "everything" I mean anything whatsoever, regardless of what ontological category it belongs to. Mountains, which belong to the category *material object*, are self-identical; propositions about mountains are also self-identical, even though they belong to a different ontological category than mountains. If the concept of parthood is strongly universal, then, necessarily, everything has parts. If the concept of parthood is strongly universal, then numbers have parts, classes have parts, material objects have parts, immaterial objects have parts, and so forth.

Even if the concept of parthood is not univocal, it might nonetheless be strongly universal. The state of affairs would obtain if, for example, although there are multiple parthood relations, each ontological category is such that (i) there is a parthood relation defined on that ontological category and (ii) every object bears some parthood relation to some object.

There is a danger of the debate between the universalist and her opponent being trivialized. Some philosophers stipulate that every object is to be counted as a part of itself. Given this stipulation, it is trivially true that the concept of parthood is universal, since identity is universal. The number two definitely has parts, since it at least has itself as a part! And so forth for objects of other ontological categories. We need to avoid this danger.

If we stipulate that every entity is to count as a part of itself, it is useful to introduce a technical term that applies when an object is a part of some whole but not identical to that whole. It is standard to use the term *proper part* in this sort of circumstance. We could avoid the danger of trivialization by asking whether the concept of proper parthood is universal. But this question, although interesting, is not the intended question.

We should distinguish the following questions:

Q1: Does every entity have proper parts?

Q2: Does every ontological category have at least one member that has a proper part?

Q1 and Q2 are not the same question; moreover, it might be that it is correct to answer "no" to Q1 and "yes" to Q2. In order to see that Q1 and Q2 are different questions, it will be helpful to assume a background ontology. Since it is reasonably familiar and well developed, let us pretend to accept David Lewis's ontological scheme. We can then see how Q1 and Q2 differ given this background, and hence differ simpliciter.

Lewis's ontological scheme is composed of two categories: *material object* and *class*.[31] Properties are identified with classes; propositions are identified with classes of possible worlds; possible worlds are in turn identified with mereological fusions of spatiotemporally related objects; events are reduced to properties. [Lewis (1986a): 69-80.] Lewis is also a mereologist. Since he is a mereologist, he believes in "mixed entities," which are composed of material objects and classes. [Lewis (1991): 72-80.] According to Lewis, there is one fundamental parthood relation that applies to both material objects and classes. Some material objects have proper parts; so do some classes. So Lewis would answer 'yes' to Q2.

But Lewis would answer "no" to Q1. According to Lewis, some entities don't have proper parts. For example, in Parts of Classes, Lewis argues that singleton classes are mereological simples. Since different answers to Q1 and Q2 are possible, this shows that these two questions are distinct.

Let us consider a third question:

Q3: Let C be an ontological category such that some member of C has proper parts. Does every member of C have proper parts?

Q3 is not the same question as Q1 or Q2. We can see that this is the case if we construct scenarios in which one could reasonable answer these questions differently. Consider McLewis. McLewis shares Lewis's basic ontology, which consists of material objects and classes.

But McLewis disagrees with Lewis about whether classes have proper parts. McLewis is a compositional restrictivist; he believes that *the* fundamental parthood relation is defined *only* on material objects. According to McLewis, either Lewis's claim that some classes have proper parts amounts to nothing more than a stipulation like "let us now call the subclasses of a class its 'proper parts'," or the claim is meaningless in the same way that a claim like "The number 2 is in my cellar" is on some accounts meaningless, or it is just plain false because the parthood relation does not apply to classes.

McLewis is happy to let Lewis stipulate a new sense of "proper part," although he worries that it might be misleading to do so, and he certainly does not think that doing this cuts any metaphysical ice. McLewis is suspicious of the second option, since he is inclined to think that the sentence "The number 2 is in my cellar" is false but not meaningless. So he favors the third option, if he is supposed to understand that Lewis is making a substantive claim.

So McLewis answers Q2 with a "no". Classes on his view do not belong to a category in which some elements of that category have proper parts. For similar reasons, McLewis answers question Q1 with a "no".

McLewis also believes in that, necessarily, every material object is atomless gunk. That is, he endorses the claim that, as a matter of necessity, every material object has proper parts. Since he also holds that only material objects have proper parts, he answers Q3 with a "yes".

McLewis's metaphysical views might be incorrect, but they are not unreasonable. And, given McLewis's metaphysical views, he must distinguish Q3 from Q1 and Q2. Given Lewis's metaphysics, he must distinguish Q1 and Q2. So Q1, Q2, and Q3 are each distinct questions.

Which question should we concentrate on? If we want to avoid the worry about our question being trivial, then we should concentrate on question Q2. If Q2 is correctly answered by a "yes", then I will say that parthood is universal. Q2 captures the intended question.

There is some linguistic evidence that we take the concept of parthood to be universal. Recall the sentences I mentioned earlier:

(1) The first measure is a part of the song.

(2) 12:30 PM is a part of the interval ranging from 12:00 PM to 1:00 PM.

(3) This part of space is curved.

(4) The third inning was the most boring part of the baseball game.

(5) The weakest part of his argument is where he confuses types and tokens.

(6) Part of what he did when he killed the butler was hit him with a candlestick.

As I noted earlier, each sentence seems plausible, even though they seem to ascribe mereological structure to objects of various ontological categories. However, some putative ontological categories seem to resist the attribution of part-whole structure to their members. For example, suppose that *numbers* form an ontological category. There are no commonsensical attributions of part-whole structure to numbers. The sentence ".33 is a part of 3.33" sounds silly. Or consider the putative category *possibilities*. The sentence "the possibility that Ben wins the chess match is part of the possibility that Ben wins the chess tournament" sounds extremely strained. This, of course, does not show that the concept of parthood is not universal. It might be the case that there are composites made out of numbers and possibilities, or that numbers and possibilities are composite objects. Or it may be that neither numbers nor possibilities form genuine ontological categories. But the case for parthood being universal would be stronger if we could produce plausible sounding attributions of mereological structure to entities of every putative ontological category.

However, even if we do not have an airtight case for universalism, we still seem to have some reason to reject the kind of compositional restrictivism endorsed by McLewis. For it seems that each of (1)-(7) could be true and it seems that each of (1)-(7) attributes part-whole structure to entities of various ontological categories. How could McLewis respond?

One strategy available to McLewis is to provide paraphrases of each of the offending sentences. For example, sentence (1), which appears to attribute mereological structure to types, could be paraphrased as follows:

> (1*) Necessarily, every instance of the song has a part that is an instance of the first measure.

In other words, talk about the mereological structure of types can be cashed out in terms of *necessity* and the mereological structure of tokens of the types. This is the strategy advocated by Alex Oliver:

> We also talk of types of geometrical objects as having parts, so that we can say that a type of a particular hyperbola has two separate parts. But I would construe this talk as mere metaphor: the type has metaphorical parts because any token of the type has *real* spatial parts. [Oliver (1993): 217]

Likewise, with respect to (7), Oliver recommends treating it as a metaphor. Classes do not literally have their proper subclasses as proper parts, although the metaphor that they do is appropriate. The metaphor is appropriate because the subclass relation and the parthood relation have similar formal properties. For example, it is uncontroversial that both relations are transitive.

Oliver also notes that, on some theories of types, such as Lewis's theory of properties, even if types have mereological structure, they do not have the mereological structure we expect them to have.[32] For example, according to Lewis's theory, properties are classes of actual and possible instances of the property. (I assume that types are a kind of property.) So a type of song is the class of its actual and possible instances. According to Lewis, the parts of a class are all and only its subclasses. But any subclass of a class of songs is itself a class of songs. It is not a class of proper parts of that song. So, on Lewis's theory, a sentence like (1) is false.

So even someone like David Lewis, who believes that there is just one fundamental parthood relation and that this relation is universal, should not take some of these sentences at face value. For another example, (5) also seems amenable to paraphrase. Instead of saying "the weakest part of his argument is where he confuses types and tokens," we could say:

> His argument has many premises. In one of his premises, he confuses types and tokens. This premise is the weakest premise of his argument.

And this sort of paraphrase might be reasonable or even mandatory depending on what we take arguments to be. If we take arguments to be sequences of sentences, as many introductory logic textbooks do, then the premises of an argument are *not* literal parts of the argument. Instead, they are "elements" of the sequences.

So the linguistic evidence for compositional universalism seems weak. Let us see what additional considerations could motivate us to hold that composition is universal.

One might appeal to the thesis that composition is identity. Many feel a strong attraction to the hard to adequately characterize but nonetheless alluring thesis that composition is identity.[33] Consider a table and its parts. In some sense, the parts of this table just *are* the table. The table just is its top and legs.

If composition is identity, then, since identity is universal, then so too is parthood. And even if composition is not literally identity but instead merely analogous to identity, a case might be made that parthood is universal. For the more analogies between composition and identity we discover, the more analogies between them we should expect to discover.

How analogous is parthood to identity given typical endurantism? The answer is: not very analogous at all. There are at least two fundamental kinds of parthood; there is only one kind of identity. The parthood relation defined on material objects is temporally relative; the identity relation does not obtain relative to times.[34] Every object is always identical to itself; however, the *xs* that compose a *y* at *t* need not be identical with the *zs* that compose *y* at *t'*. The typical endurantist should deny that composition is identity.

So if we hold that compositional pluralism is true, and that the parthood relation defined on times is not the parthood relation defined on material objects, the thesis that composition is identity is problematic and cannot motivate the claim that there are parthood relations defined on each ontological category. We might wonder why only certain ontological categories have parthood relations defined on them, but perhaps the compositional pluralist can provide an explanation: perhaps only those objects that can occupy space or time in some intimate way, such as material objects, events, spatial or temporal regions, can have parts.

However, the typical perdurantist is not in this position, for she need not accept compositional pluralism. Suppose that compositional pluralism is false, and that the parthood relation that events bear to each other, that material objects bear to each other, and that regions of spacetime bear to each other, is the same in each case. Then we would feel some pressure to think that, for example, the relationship between classes and their subclasses is also that parthood relation. For one thing, the subclass relation is formally analogous to the parthood relation. Since the parthood relation appears in four other ontological categories, the hypothesis that this formal analogy is not merely a formal analogy would be very tempting. But clearly it is not required.

So the typical endurantist probably has no reason to hold that parthood is universal, and may have some reason to think it is not. But the typical perdurantist is not in the same position; she may hold that parthood is universal, but the evidence we have looked at does not mandate this conclusion.

Notes

[1] I follow the convention that "part" denotes a reflexive relation.

[2] Peter Simons stresses this point throughout Simons (1987).

[3] On standard mereology and other interesting variations of it, see Simons (1987). Simons is, of course, no compositional monist; Simons (1987) provides a powerful defence of compositional pluralism. Peter van Inwagen appears to endorse compositional pluralism in van Inwagen (1990a): 18-20. One famous monist is, of course, David Lewis. See Lewis (1991): 75-82.

[4] One could hold the stronger view that there are multiple parthood relations within each particular ontological category. But I can't see how one could motivate such a view. Accordingly, I will not address it in what follows.

[5] On the 'unmereological composition' of states of affairs, see Armstrong (1986), and Lewis (1986b).

[6] For arguments against states of affairs, see Lewis (1986b).

[7] This question is clearly related to the question Peter van Inwagen calls the *General Composition Question*. On this question, see van Inwagen (1990a): 38-51.

[8] Of course, we can introduce *defined* parthood relations that, for example, are not transitive.

[9] However, it might be that, for each ontological category, there is something analogous to inherited location that we can appeal to. For example, classes inherit their members from their subclasses.

[10] The problem facing the advocate of the thesis that composition of is identity is analogous to the problem of contingent identity. Counterpart theory can solve the latter problem, so it may solve the former one as well. See Lewis (1971) and Mericks (1999). For the record, I reject mereological essentialism.

[11] Krecz applies the part/piece distinction to fictional and linguistic objects in Krecz (1986): 391-394.

[12] "There is something arbitrary about a piece of a whole, something nonarbitrary about a part of it." [Krecz (1986): 392].

[13] Since (4) is arguably incoherent, I ignore it in what follows.

[14] Defenses of constitution can be found in Baker (1997), Baker (2000), Wasserman (2002), and Wiggins (2001).

[15] Mierav is not clear on what the relevant features of the parts are. Let us assume that they are the intrinsic properties of the parts, plus the various spatiotemporal and causal relations obtaining between them.

[16] I am indebted to the work of cody Gilmore in what follows. Some of the remarks made here are similarly to those in Gilmore (forthcoming).

[17] For an interesting discussion about eternalism see chapter two of Sider (2001) and Markosian (1994).

[18] No surprise here, since Lewis is the author of both arguments. See Lewis (1986): 202-205.

[19] Sometimes this relation is called an *atemporal* part-whole relation.

[20] Another popular target is eternalism. Many philosophers instead endorse *presentism*, which is the doctrine that the only things that exist are those things that presently exist. On presentism, see Bigelow (1996), Markosian (1994), and Sider (2001).

[21] Hud Hudson presents a more developed account of a view that indexes the part-whole relation to regions in Hudson (2001): 62-70.

[22] Perhaps it is not the only reason. Recently, Hud Hudson has argued that indexing the part-whole relation to regions of spacetime also solves the pressing problem of the many. See Hudson (2001): 45-71. Additionally, Theodore Sider has suggested that the three dimensionalist should index parthood to regions of spacetime in worlds in which time travel into the past is possible. See Sider (2001): 104-105.

[23] I am heavily indebted to Theodore Sider for what follows here.

[24] See Sider (2001): 84-85. Phillip Bricker has pointed out to me that we can also say that an entity is a time just in case it is a three dimensional spacelike hyper-plane. Let us call the entities that I call times in the body of the text '1-times' and the three dimensional spacelike hyper-planes '2-times'. On this proposal, 2-times simply are certain spatiotemporal regions, specifically, those regions that are fusions of the elements of some 1-time. Note that on this proposal, indexing parthood to a time simply is indexing parthood to a region, since every time is a region of spacetime.

[25] This procedure is a modification of a proposal made by Theodore Sider in Sider (2001): 84-85. According to Sider's proposal, we begin by taking the notion *x overlaps y at spacetime point R* as our mereological primitive. We then introduce a time-frame indexed notion of parthood as follows:

> *X overlaps y at t at F* = df. there is a spacetime point *p* in *t* at *F* such that *x* overlaps *y* at *p*.
>
> *X is a part of y at t at reference frame F* =df. everything that overlaps *x* at *t* at *F* overlaps *y* at *t* at *F*.

I prefer my account of part at *t* at F over Sider's account because it seems clear that ordinary objects cannot be wholly present at spacetime *points*.

[26] Since the perdurantist believes in an atemporal parthood relation, she can provide definitions of these concepts that are (from her perspective) more perspicuous:

> *X* is an *extended temporal part of y* at interval *T* =df. (1) *x* exists at every instant in *T* and at no instant not in *T*, (2) *x* is a part of *y*, and *x* overlaps everything that is a part of *y* and that exists at *t* in *T*.

[27] For arguments against coincidence, see Sider (2001): 140-208.

[28] It may be that some endurantists wish to deny this; perhaps they hold that if some object occupies regions *r1* and *r2*, then it occupies the union of these regions as well. This additional claim seems gratuitous, and is certainly not an essential part of the view.

[29] This appears to be Lewis's position as well. See Lewis (1997b): 227.

[30] For a defense of Parsonian extended simples, see Parsons (2000).

[31] Although Lewis is willing if need be to admit in his ontology either tropes or universals, he is officially neutral on whether they exist. See Lewis (1997a).

[32] Alex Oliver stresses this point throughout Oliver (1993).

[33] Although it is hard to adequately characterize this view, it is clear what some of its implications are. One clear consequence of this view is that it is impossible for two non-identical things to be made of the same parts. On composition as identity, see Lewis (1991): 81-87, Sider (forthcoming), and van Inwagen (1994).

[34] One way to save the claim that composition is identity is to hold that identity is also temporally relative. On this view, see Gallois (1998).

CHAPTER 2

A DEFENSE OF THE BRUTAL VIEW OF SIMPLES

2.1 Introduction

An object is a simple if and only if it has no proper parts. (x is a proper part of y just in case x is a part of y but x is not identical to y.) This is a *definition* of the word "simple," not a substantive criterion for being a simple. The Simple Question asks "under what circumstances is an object a simple?"[1] An answer to the Simple Question is an *informative* instance of the following schema:

Necessarily, x is a simple if and only if __________.

In other words, an answer to the Simple Question must provide necessary and sufficient conditions for being a simple, and it must not employ a mereological term on the right-hand side of the biconditional. An answer to the Simple Question is a substantive criterion for being a simple.

I will argue that there is no correct, finitely stateable, and non-circular answer to the Simple Question. There is no non-mereological criterion for being a simple. I call this view *the Brutal View*.

My argument for the Brutal View is indirect and hence somewhat shaky. I argue that every reasonable answer to the Simple Question faces serious objections. Consequently, the Brutal View is the only view left standing. In section 2.2, I motivate the quest to answer the Simple Question and briefly describe the space of possible answers. In sections 2.3, 2.4 and 2.5, I present arguments against the competitors of the Brutal View. In section 2.6, I respond to arguments against the Brutal View.

2.2 The Simple Question

Why care about the Simple Question? First, issues involving the nature of simplicity are not independent of other concerns in the metaphysics of material objects. Philosophical puzzles concerning material constitution have received a deserved share of the attention of contemporary philosophers; much of it focused on what Peter van Inwagen has dubbed the *Special Composition Question*, which is: what are the necessary and jointly sufficient conditions that some objects must meet in order to compose a single object?[2] Ned Markosian, the philosopher to whom we owe gratitude for raising the Simple Question, notes the connection between these two questions in the following passage:

> simples are the basic building blocks that, when combined in various ways, make up all other objects. Thus it is natural to think that what we say about the nature of simples will have considerable bearing on what we say in response to the Special Composition Question. [Markosian (1998a): 214].

To see that Markosian is correct, let us consider a radical answer to the Special Composition Question called *Nihilism*.[3] Nihilism is the view that, necessarily, nothing is a composite object. Nihilism obviously conflicts with common sense concerning what objects exist, since one consequence of Nihilism is that there are no such things as tables, rocks, and living human organisms.[4] But the advocate of Nihilism at least agrees with common sense that there are material objects. However, given Nihilism, these must be mereological simples. If it turns out that nothing could satisfy what it takes to be a simple, or even if nothing in fact does satisfy what it takes to be a simple, then Nihilism is refuted.

That the Special Composition Question is an interesting question is established by the fact that so many metaphysicians are interested in it. Since answering the Simple Question could shed light on the Special Composition Question, we should be interested in it as well.

Second, an answer to the Simple Question could help us decide whether *atomless gunk* is possible. An object is *gunk* just in case every part of it has proper parts. There are longstanding debates about whether gunk is possible. The question of the possibility of gunk is also relevant to answering the special composition question; recently, Theodore Sider has argued that certain answers to the Special Composition Question are false because they rule out the possibility of gunk. [Sider (1993)]. Additionally, Dean Zimmerman has argued that certain theories about the nature of masses are ruled out given the possibility of atomless gunk. [Zimmerman (1995)]. If gunk is impossible, then these arguments have no force. An answer to the Simple Question may help us assess these arguments.

Another strange and putatively possible kind of object that has attracted its share of defenders is the *extended simple*. An object is an *extended simple* just in case it is extended in space (or spacetime) and yet lacks proper parts.[5] Speculation about the possibility of extended simples is not confined to philosophy. In a recent article, Mark Scala presents evidence that Isaac Newton believed that the fundamental objects of this world are extended simples. [Scala (2002): 394].[6] And, more recently, in a popular book on string theory, the physicist Brian Greene seriously entertains the possibility that fundamental physics will imply the existence of extended simples:

> What are strings made of? There are two possible answers to this question. First, strings are truly fundamental- they are "atoms", uncuttable constituents, in the truest sense of the ancient Greeks. As the absolute smallest constituents of everything, they represent the end of the line… From this perspective, even though strings have spatial extent, the question of their composition is without any content. Were strings to be made of something smaller, they would not be fundamental. [Greene (1999): 141].

If we had an answer to the Simple Question, this presumably would help us determine whether extended simples are possible. (In chapter three, I provide an extended defense of the possibility of extended simples.)

So we should agree with Markosian that an examination of the Simple Question is relevant to an examination of the Special Composition Question. Moreover, it is an interesting question in its own right. Markosian should be commended for raising it.

I will argue that there is no correct, finitely stateable, non-trivial answer to the Simple Question. I call this view the *Brutal View of Simples*.[7]

It is not part of the Brutal View that there are no informative *necessary* conditions on being a simple. In fact, I believe that there are. But there are no informative conditions that are *both* necessary and sufficient for being a simple. I distinguish the Brutal View from the claim that, for any simple *S*, it is a brute fact that *S* is a simple. We can call the latter view *the Brutal View of Facts about Simplicity* (BFS). If there are informative sufficient conditions for being a simple, then BFS is false. But, as long as these sufficient conditions are not necessary conditions, then the Brutal View is unthreatened by the falsity of BFS.[8]

It is also not part of the Brutal View that there are no features that are contingently correlated with being a simple. It is my hope that there are. But, whatever they are, it is up to empirical science and not *a priori* philosopy to discover them.

Still, it is unfortunate that the Brutal View is true. For the Brutal View sheds no light on the question of whether atomless gunk is possible, whereas other answers to the Simple Question appear to. And the Brutal View provides us with no help with the question of whether extended simples are possible, whereas other answers to the Simple Question have something to say about the possibility of extended simples. The Brutal View does not tell us that atomless gunk or extended simples are possible, and it does not tell us that they are impossible.

Although the Brutal View of Simples is a dissatisfying answer to the Simple Question for these reasons, I believe that there is a compelling reason to embrace it: the competitors to the Brutal View face problems serious enough to warrant rejecting them. If this is the case, the Brutal View is the only game in town.

What are the competitors to the Brutal View? As I see things, the other main players are the following:

(a) *spatial accounts*

- (1) *The Pointy View of Simples* (PV)
- (2) *The Maximally Continuous View of Simples* (MaxCon)

(b) *fundamentality accounts*

- (3) *The Instance of a Fundamental Property View of Simples* (Instance)
- (4) *The Independence View of Simples* (Independence)

(c) *indivisibility accounts*

- (5) *The Physically Indivisible View of Simples* (PIV)
- (6) *The Revised Metaphysically Indivisible View of Simples* (MIV)

In section 2.3, I present and argue against the spatial accounts.[9] In section 2.4, I present and argue against the fundamentality accounts. In section 2.5, I present and argue against the indivisibility accounts.

2.3 Spatial Accounts of Simplicity

2.3.1 General Objections to the Spatial Accounts of Simplicity

As the name suggests, spatial accounts of simplicity appeal to spatial features to provide a criterion of simplicity. The two most promising spatial accounts are:

The Pointy View of Simples (PV): necessarily, *x* is a simple if and only if *x* is a point-sized object.

The Maximally Continuous View of Simples (MaxCon): necessarily, *x* is a simple if and only if *x* is a maximally continuous object.[10]

According to the Pointy View, simples are all and only point-sized objects. If you want to make a simple, create a point-sized object. (Don't ask me how to do that!) The Pointy View is probably the traditional view of the nature of simples.

The Pointy View has two interesting features. First, if material objects without point-sized parts are possible, then the Pointy View implies that gunk is possible. [Markosian (1998a): 216]. Second, the Pointy View clearly implies that extended simples are impossible.

MaxCon is not for traditionalists! Given MaxCon, if you want to make a material simple, here is the recipe you should follow. First, pick the region of space that you want the simple to exactly occupy. Let us call that region "R". If R is a continuous region of space, then proceed to the next step. Otherwise, start again. Assuming that R is a continuous region of space, completely fill R with matter; make sure that there is no subregion of R where matter cannot be found. Finally, make sure that R is not part of some larger continuous region of space that is also filled with matter. If it is not, then R now contains a material simple.

Presumably, R can be any size or any shape; the only constraint on R is that it be occupiable by a material object. Given MaxCon, there can be extended simples of any shape or size.[11] What about gunk? If MaxCon is true, then gunk is impossible.[12] MaxCon is a stunningly unorthodox answer to the Simple Question.

Note that spatial accounts of simplicity at most provide an account of when objects that can have spatial properties, such as material objects or regions of space, are simples.[13] But, as noted in chapter one, we seem to ascribe parts to other kinds of objects as well. We ascribe part-whole structure to *events*: the third inning was the best part of the baseball game; to *arguments*: the weakest part of the argument is where he confuses numerical and qualitative identity; to intervals of time: this morning was the best part of the day. Moreover, it seems as though we can conceive of simple immaterial objects. For example, many theists believe that God is immaterial and simple. It seems that this position is coherent. Similarly, Descartes argued that he is an immaterial substance without parts.

If one accepts that the concept of parthood is univocal and universal, then one might hope for a unified account of what it is to be a simple, one that simples from every ontological category could meet. Although it would be nice to have a non-disjunctive account of simplicity that could apply to entities from every ontological category, I suspect that this is too much to hope for, even given that the concept of parthood is univocal and universal. The Pointy View could explain why some regions of space or spacetime are simples, in addition to why some material objects are simples;

possibly it could also explain why certain events are simples. But the Pointy View has no clear application to other categories. MaxCon is hopeless as an account of the simplicity of spatial or spatiotemporal regions, and it is implausible if it is expanded so as to apply to events. At best, MaxCon provides a criterion of physical simplicity.[14]

So, for now, we restrict the scope of our inquiry. Let us focus on the question of when a material object is a simple. If some answer to the Simple Question seems capable of providing a non-disjunctive account of simplicity *simpliciter*, we will note that.

The main argument against spatial accounts of simplicity is based on the possibility of co-located point-sized objects.[15] Two objects are co-located if they exactly occupy the same region of space (at the same time).[16] The argument is as follows: (1) co-located point-sized objects are possible; (2) if co-located point-sized objects are possible, then mereologically complex point-sized objects are also possible. But then both the Pointy View and MaxCon are false.[17]

There are several ways someone could motivate the premises of this argument. First, there is the argument from speculative ontology: one might claim that even point-sized objects have their properties as parts. D.M. Armstrong distinguishes two conceptions of particulars: a "thin" conception, according to which a particular is "bare", and a "thick" conception of particulars, according to which particulars are "clothed." [Armstrong (1997): 60, 94-96]. According to the thick conception of particulars, particulars literally have their properties as constituents. On this conception of particulars, even point-sized thick particulars have parts.[18]

Armstrong's views on particulars and properties are controversial, and I don't want to rest my case on them. Accordingly, let us consider a second reason to believe premise one, which is the argument from conceivability. We can form a clear and distinct conception of co-located material objects; they are conceivable. This gives us a reason to believe that they are possible.[19] For example, we can imagine two different kinds of matter that are capable of interpenetrating.

We need not base the case for the conceivability of co-located objects on the strange thought experiments of a philosopher. There is an interesting debate in the philosophy of quantum mechanics about whether *bosons*, a kind of fundamental particle, are counter-examples to the Identity of Indiscernibles.[20] Bosons are counterexamples to this law only if two or more of them can be at the same place at the same time. Peter Simons, in a recent paper on the bundle theory of objects, makes the point nicely:

> *Fermions*, which include electrons, are characterized by [properties] which obey the *Pauli Exclusion Principle*: no two fermions can be in exactly the same state. Thus the reason that a helium atom may have two electrons in its innermost shell is that their spins are in opposite directions, so they differ in one [property] (maybe a second-order [property]: spin-*direction*). ... The other sort of particles are *bosons*. They do not obey the Pauli Principle, and so ***two or more bosons can be in the same state at the same time, in particular they can be in the same place at once and not differ in any* [property] *at all.*** If electrons were bosons, they could all three occupy the same space around a lithium nucleus. The most familiar bosons are photons, and it is their superposability in large numbers that makes lasers possible. [Simons (1994): 379-380].[21]

I am no expert on quantum physics, so I am unable to evaluate Simons's claim here. But I am not trying to argue that co-located objects are actual. What this example shows is that co-located material objects are conceivable, and even play a role in certain physical theories. And this provides a reason to think that they are metaphysically possible. It may be that at the end of the day speculative physics will postulate co-located material objects. It seems to me that we should not disregard this possibility *a priori*. That both spatial accounts of simplicity do eliminate this possibility *a priori* is problematic.

Finally, there is the argument from systematic modal metaphysics: the mere metaphysical possibility of co-located objects follows from familiar Humean principles involving the denial of necessary connections between distinct existences. Suppose two point-particles are approaching each other at a rapid clip. If co-located material objects are impossible, then they must swerve out of each other's way. Or they must stop dead in their tracks. Or one of them must spontaneously disintegrate. Some event must occur in each world that prohibits them from occupying the same space. There is a *de re* necessary repulsion between these two objects. The price of denying the possibility of co-located objects is accepting brute *de re* modal facts like these. The price is too high.[22]

The state of affairs in which an object *x* occupies a particular region of space *R* (at *t*) is distinct from the state of affairs in which an object *y* occupies the same region (at the same time). From the fact that the first state of affairs obtains, we can infer nothing about the location of *y*. Both states of affairs obtain contingently. If any recombination of distinct, contingent states of affairs yields a genuine possibility, as I am inclined to hold, then there are possible worlds at which both *x* and *y* occupy *R* (at *t*).[23]

Why believe premise (2), which says that if co-located objects are possible, then so are objects composed of them? Suppose that in some possible world two point-sized objects occupy the same region of space. Then it also seems possible that there be a thing made out of those objects. For example, suppose the two objects always move together because they are held by a fundamental physical force. Surely there are possible worlds in which the laws of nature guarantee this sort of interaction. If this scenario arose, we would be tempted to say that the two objects were "joined together," "bonded," or "fused." In such a case, one would be hard pressed to say that they do not compose something. I suspect only the mereological nihilist could resist this pressure. But, if the objects do compose something, then this composite object is a counter-example to the spatial accounts of simplicity.[24]

One more remark on co-location before I move on. I am inclined to accept that the following is a *sufficient* condition for being a simple: being point-sized and not co-located with any other point-sized object. Given this, some point-sized objects might be simples in virtue of having this property.[25] But it is not a necessary condition on being a simple. For the two co-located simples that composed the counter-example to the spatial accounts are still simple, despite their being co-located.

2.3.2 Special Problems for MaxCon

MaxCon is an interesting view. It faces interesting objections over and above those facing the Pointy View. I will now discuss a series of these objections.

2.3.3 MaxCon in a Relativistic Setting

MaxCon was first introduced and defended by Ned Markosian in Markosian (1998a). We should note that when explicating MaxCon, Markosian presupposed a controversial view about how objects persist through time, endurantism. Recall that, roughly, endurantism is the view that material objects persist through time by being wholly present at each instant at which they exist. According to the standard account of endurantism, the parthood relation has an extra "argument place" for times.[26] Accordingly, given endurantism, the primitive parthood relation is *x is a proper part of y at t*.

But, as I argued in chapter one, strictly speaking, the endurantist should index parthood to spacetime regions, not to times, because of considerations stemming from special relativity. How does this fact change our evaluation of MaxCon?

The formulation of MaxCon given in the previous section employs the notion of a continuous region of space. But some scientists and philosophers have argued that one consequence of the special theory of relativity is that space and time as commonly conceived simply do not exist; there is no enduring manifold of spatial points. Strictly speaking, there are no *times* or *spatial points*; the zero-dimensional entities at our world are space-time points. If these scientists and philosophers are correct, how are we to understand MaxCon? And are there special difficulties facing the MaxConist stemming from special relativity?

It is beyond my competence to answer the second question authoritatively. Here I present and discuss what I take to be the two obvious ways of formulating an analogue of MaxCon in a relativistic setting. Let us begin by asking what counts as a continuous region of space given special relativity. Nothing *simpliciter*. But there may be continuous regions of space *according to a reference frame*, where continuous regions of space may be thought of as follows. Relative to some reference frame, all points of space-time divide into equivalence classes that may be thought of as times (since simultaneity is a three-place relation between two events and a frame of reference). Any subset of any of these equivalence classes of space-time points (at some reference frame) may be thought of as a region of space (at that reference frame). A continuous region of space, relative to frame F, may then be thought of as any continuous region of spacetime, such that every member of the region is simultaneous with every other, relative to F. We can now formulate a relativistic version of MaxCon:

> **SR-MaxCon:** Necessarily, *x* is a simple at *t* according to reference frame F if and only if *x* is a maximally continuous object at *t* according to reference frame F.

This formulation of MaxCon seems consistent and available to the MaxConist. It is admittedly strange that *being a simple* (and accordingly, the parthood relation) is relativized to both a time and a frame of reference, but perhaps this is merely another consequence of grafting the endurantist perspective of persistence through time onto this philosophical account of the theory of special relativity. It is, however, worrisome that parthood is being indexed to "times" and "frames of reference" in this fashion, since both kinds of entity are not fundamental.

The second way to modify MaxCon to accommodate special relativity is to take a maximally continuous object to be one that occupies a continuous region of *space-time*. We define what it is for an object to be *maximally continuous* as follows:

> *x* is a *maximally continuous object* $=_{df}$ *x* is a spatiotemporally continuous object and there is no continuous region of space-time, R, such that (i) the region occupied by *x* is a proper subset of R, and (ii) every point in R falls within some object or other.

We now state the spatiotemporal analogue of MaxCon:

> **4DMaxCon:** Necessarily, *x* is a simple if and only if *x* is a maximally continuous object.

Although 4DMaxCon is the more natural way for the MaxConist to accommodate special relativity, it is in some ways more problematic. I have two worries about 4DMaxCon. First, let me introduce the concept of a *spanner*. Roughly, a spanner is a spatially continuous object that persists through a continuous interval of time. Less roughly:

> An object *x* is a *spanner* $=_{df}$ (i) for any reference frame F, the set of times at F at which *x* is present is a non-instantaneous continuous interval and (ii) *x* is a spatially continuous object at every time at F for which *x* is present.

My first worry about 4DMaxCon is that it may be that the fundamental physical particles studied by physicists, e.g., the electrons, quarks, etc, are spanners. Even if they are not, there clearly are possible worlds where the fundamental physical particles are spanners. According to 4DMaxCon, spanners are simples. Assume for a moment a generous mereology, such that for any collection of objects, the *xs*, there is a *y* such that *y* is the mereological fusion of the *xs*. Even granting such a generous mereology, there is no room for human persons in worlds in which the fundamental physical particles are spanners and have lifetimes relevantly similar to those in the actual world. There are only particles and fusions of particles; there are no particle slices, i.e., proper (spatio)temporal parts of particles, to compose shorter-lived human persons or persons relevantly similar to human ones in these worlds, since the temporally extended fundamental particles are simples. Since some of the close possible worlds containing spanners (perhaps including the actual world) also clearly contain human persons, 4DMaxCon must be false.

Here is my second worry about 4DMaxCon. Let us pick an arbitrary reference frame F according to which there are times t1 and t2. Imagine that at time t1 two homogenous portions of the same kind of matter fill continuous non-overlapping spatial regions. The two portions of matter move closer together until at t2 the union of the spatial regions occupied by the portions of matter is spatially continuous. After t2, the portions of matter go their separate ways, never to intersect again. Surely we would describe a possible world in which this occurred as one that contained (at least) two objects. However, if 4DMaxCon is correct then there is only one object in the story, since the spatiotemporal region occupied by the portions of matter in the story is continuous. Since this seems false, there is reason to worry that 4DMaxCon is not the correct account of what a simple is.[27]

These worries are reasons to prefer SR-MaxCon to 4DMaxCon. However, given that I do not see any serious worries for SR-MaxCon over and above the worries that I will raise concerning MaxCon, I will henceforth ignore the more complicated relativistic formulations of MaxCon and instead address their simpler and more intuitive cousin.[28]

2.3.4 The Problem of Spatial Intrinsics

As I see things, the main philosophical objection facing MaxCon is an argument that I call *the Problem of Spatial Intrinsics*. Suppose that there are two extended simples, A and B, such that they both occupy non-overlapping cubical regions of space. A and B have the same volume.

Let us say that a property P is *fundamental* just in case there are no other properties or relations such that P is instantiated *in virtue* of those properties being instantiated. A and B are not qualitative duplicates, for A has a fundamental intrinsic property, which I will call *redness*, whereas B has a different fundamental intrinsic property, which I will call *blueness*. Suppose that A and B move closer together until at time *t* they come into perfect contact.[29] Now the union of the regions of space occupied by A and B is a continuous region. (Suppose also that this region is not a subregion of a larger, continuous, matter-filled region.) If MaxCon is true, then at time *t*, A and B are destroyed, and a new simple, which I will unimaginatively call "C", comes into being.

Why do I describe the case this way? If either A or B survive, then the survivor must be identical with C. It is not the case that both A and B survive for their doing so would imply a denial of the transitivity of identity. It would be highly arbitrary for the MaxConist to claim that one survives and not the other. Could the MaxConist claim that A, B, and C each exist at *t* but that C does not have A and B as parts? This seems highly implausible. First, if either A or B exists at *t* (and is not identical to C), then given MaxCon, they now have an infinity of parts.[30]

What is C like? What are C's properties? There is pressure to say that C is blue *at some subregion R* and *red at a distinct region, R**. It seems reasonable to talk like this, provided that the spatial indexes on the instantiations of blueness and redness are reducible. That is, we could make sense of the idea of an object having a property at a region if we could analyze this as follows:

> X has F at R just in case there is some y such that y is a part of X, y exactly occupies R, and y has F.

But this analysis is not available to the advocate of MaxCon. In the case just told, C is a qualitatively heterogeneous extended *simple*. It does not have a part where it is blue; instead, it is just blue *there*. How then should we understand the claim that C is blue at R?

This is the problem of spatial intrinsicis. It is analogous to the problem of temporal intrinsics. Objects can enjoy different intrinsic properties at different times; they enjoy *temporal qualitative variation.* Similarly, objects can enjoy *spatial qualitative variation* by having different intrinsic properties at different regions of space. They typically do this by having different spatial parts that have these properties *simpliciter*. But an extended simple does not have spatial parts.

Markosian argues that the MaxConist should claim that, even though no object survives in the contact case just mentioned, persisting *matter* or *stuff* does survive, and this stuff instantiates these intrinsic properties. Markosian argues that the MaxConist needs to appeal to *stuff* anyways, in order to accommodate other intuitions we have. Recall that, when two maximally continuous objects come into contact, one of them must be destroyed. This seems strange. Markosian writes:

> the matter that constitutes each of the original [maximally continuous objects] does not go out of existence simply because the two [objects] have bumped up against each other. Thus here… it will be important for the MaxConist to distinguish talk of objects from talk of matter, and appeal to the latter in satisfying certain intuitions that cannot otherwise be reconciled with them. [Markosian (1998a): 226].

However, I am suspicious about certain applications of this strategy. Given MaxCon, not only is it possible that there be simples of strange shapes and sizes (imagine a planet-sized simple), but there can be simples of terrific complexity as well. Not mereological complexity, since simples have no proper parts, but MaxCon does not rule out the possibility of a simple exactly occupying a region filled with a vast multitude of stuffs of various kinds. Consider: although persons are not constituted by continuous stuffs, surely such persons are possible provided the arrangement of the matter that fills the regions occupied by such persons is suitably complex and functionally integrated. Thus, given MaxCon, it is possible that there be persons who are mereologically simple. Suppose that two of these simple people come into contact. Given our earlier discussion, we should believe that at least one of these persons is destroyed (perhaps both are). I find that my intuition that such persons are not destroyed by contact to be so strong that it is not satisfied with the claim that the matter that formerly filled the regions occupied by them is not destroyed. Perhaps the two persons are concluding what has been a heated philosophical debate; surely, these persons could safely shake hands and say 'good bye' without also saying their last good-byes. So it is not clear to me that appealing to matter or stuff always helps.[31]

How might an appeal to matter or stuff help with responding to the problem of spatial intrinsics? Markosian holds that, given a commitment to irreducible stuff, we can analyze claims of the form *x is F at region R* in terms of the properties of this stuff:

> *x* is F at *R* just in case either (i) *x* has a part, *y*, such that *y* is located at *R* and *y* is F or (ii) there is some stuff that constitutes *x* and some portion of that stuff is located at *R* and is F.

Adopting this analysis will allow the MaxConist to avoid the problem of spatial intrinsics. However, in a very strict sense, the spatially indexed properties had by extended simples are had in virtue of properties had by *no things at all*.[32]

An object exactly occupies some region of space. Some matter exactly fills that same region of space. What is the relationship between the matter that fills a region and the object that occupies that region?

I say that the object just *is* the matter that exactly fills the region it occupies. (On this issue, see McDaniel (2003a).) Matter as Markosian conceives it seems to be very thing-like; it can fall under different kinds, instantiate properties, change position in space, persist through time, and undergo change; moreover, matter always comes in *thing-like* portions. In order for talk about matter to do the work that Markosian wants it to do, we need the resources of quantification over portions of matter. Why don't they count as *things*?

However, a thing/stuff dualism is exactly what the MaxConist seems compelled to endorse. We have seen that the MaxConist is committed to claiming that talk about matter is not always translatable into talk about things.[33] But, if the truth-value of statements about the persistence through time of matter can vary independently from the truth-value of statements about the persistence through time of the objects that exactly occupy the same region filled by the matter, then it must be that the reason that talk about matter is not translatable into talk about things is that *matter* and *thing* are independent ontological categories, irreducible to each other.

It is this kind of dualism that was rejected in the introduction. The world is a world of things, not a world of stuff and things. So I find this way of dealing with the problem of spatial intrinsics unacceptable.

However, there are other possible responses to dealing with the problem of spatial intrinsics. Let us now turn to them.

One possibility is to claim that the instantiation relation is actually a three-place relation between an object, a property, and a place. This strategy is analogous to the first kind of adverbalist strategy discussed and rejected in the introduction. I reject it as well. A better way to implement this strategy is to hold that there are many distinct instantiation relations. There is no single relation of instantiation; there is more than one way in which an object can have a property. Some objects, such as extended simples, have their properties in a spatial kind of way; other entities, such as numbers, have their properties in an aspatial way. Both of these kinds of instantiation relation will need to be taken as irreducible, since it is clear that the MaxConist cannot analyze talk of instantiation-at-a-region in terms of 'just plain instantiation', parthood and location. So, on this view, for each region of space R, there is a relation *instantiates-at-R*.[34]

This is analogous to the second way of being an adverbalist. And, as before, my main complaint with this view is that I do not understand it. I reject this claim as well.

Fortunately, there is another way to understand the claim that C is F at R. We could take this claim to be an attribution to C of a relational property, *being such as to stand in the F relation to R.* Alternatively, we could take this claim to assert that a two-place relation, *Fness*, obtains between C and R. On the first account, we are attributing a property to C, but it is a relational property. On the second account, we are claiming that a relation, not a property, obtains between C and R. On either account, we are not mentioning the property that we mentioned when we said that, at *t1*, A has F. I will address the latter option in what follows, although I don't think much turns on this choice.

Recall our example. A is red at t1, B is blue at t1, and at t2, A and B come into perfect contact. They are destroyed at t2 and replaced by C. At t2, nothing is blue and nothing is red. But C exists, and it bears the *red-at* relation to R1 and the *blue-at* relation to R2.[35]

One worry about this strategy is that, since the relation of being red-at is not identical to the property of being red, we might worry whether the relationalist is allowed to give them such similar sounding names. Why is the relationalist justified in calling the blue-at relation by that name, when it is not identical to the property of being blue?

I do not think that this is a major problem for the view. If the relation *being red at* plays a role in the laws of nature that is similar to the role that is played by the property *being red*, then the relationalist is justified in giving them similar-sounding names. For example, suppose that, whenever we see a red object in conditions S, we have a particular kind of perceptual experience E. Moreover, whenever we see an object that is red-at a region while in conditions similar to S, we have a token of E. (And this is what explains why C looks like it has a red part, even though it does not.) If enough of these similarities exist, then it is not unreasonable that the relationalist gives them similar- sounding names. The relation and the property behave in very similar ways.

The relationalist's strategy is coherent. I think I understand how it works, since I understand instantiation, and I believe in relations, regions of space, and material objects. So I have no problem understanding how there could be relations between a material object and a region that figure in the laws of nature in the way that the relationalist's strategy requires.[36] My main worry is that the relationalist's story does not save MaxCon from the worry I raised at the beginning of this section.

Let us distinguish those intrinsic properties that are *qualitative* from those that are, broadly speaking, *geometrical*. An example of a qualitative property is *charge*; an example of a geometrical property is *being shaped like a box*. On the assumption that the shape properties of material objects are intrinsic properties, then there is some change of intrinsic properties whenever two objects come into contact, since when that occurs, different shape properties become instantiated.[37] But it is not obvious that there must be some change in which *fundamental qualitative* intrinsic properties are instantiated when two objects come in contact.

Imagine a possible world in which two objects that differ with respect to their fundamental qualitative intrinsic properties approach each other until they stand in perfect contact. Let us consider intrinsic properties A and B which are such that it is nomologically impossible that they are instantiated by the same object. You can do this; I described a scenario in which this occurs at the beginning of this section. Now consider a possible world in which the laws of nature are such that merely bringing two objects into perfect contact with one another is not sufficient to bring about either the instantiation of a new fundamental qualitative intrinsic property or the non-instantiation of a fundamental qualitative intrinsic property that was previously instantiated. I think that you can do this as well. But, if MaxCon is correct, there is no such world.

For when the things bearing A and B come into contact, there is nothing to bear A or B. Given MaxCon, the original objects that bore A and B no longer exist, since they have been destroyed by coming into contact with each other. The resultant object cannot instantiate both of these properties, since, by hypothesis, they are nomologically incompatible. And these properties cannot be instantiated without being instantiated by something!

My intuition that there are possible worlds of the sort just described – and ruled out by MaxCon – is not satisfied by the claim that, in the worlds in which contact occurs, relations between objects and regions – relations that figure in laws similar to those that governed the properties that are dissipated by contact – are suddenly instantiated. I grant that this *could* happen; there are worlds in which it does.[38] But none of those worlds is the one that I was imagining, and it is also a possible world. Since MaxCon implies that it is not, I reject MaxCon.

2.4 Fundamental Accounts of Simplicity

Both of the views that I wish to discuss here tie simplicity to some ultimate feature of objects. They are:

The Instance of a Fundamental Property View of Simples (Instance): *x* is a simple if and only if *x instantiates* a perfectly natural property.[39]

Th-e Independence View of Simples (Independence): *x* is a simple if and only if it is metaphysically possible that *x* is the only material object that exists.

I will examine Instance first. In order to properly state Instance, I need to invoke some controversial metaphysical machinery. I assume the existence of *perfectly natural properties*.[40] It is these properties that ground *objective similarity*: if two things instantiate the same perfectly natural property, then they are objectively similar in that respect; *duplicates* are objects such that there is a 1-1 correspondence between their parts that preserves perfectly natural properties (and perfectly natural relations). Whether two things are objectively similar is metaphysically independent of our interests, desires, beliefs, or classificatory schemes.[41]

Once we have the concept of a natural property, we can define other useful concepts. [Lewis (1986): 62-63]. Intrinsic properties are properties that never differ between duplicates; if A and B are duplicates and A has intrinsic property F, then so does B. External relations do not supervene on the qualitative character of their relata; however, they do supervene on the qualitative character of the fusion of the relata. External relations should be contrasted with *extrinsic* relations, which do not even supervene on the qualitative character of the fusion of their relata. An example of an extrinsic relation is ownership. Ownership does not supervene simply on the qualitative character of the owner and the owned; instead, it supervenes on that character taken along with the various social facts that accompany it.

The perfectly natural properties (and relations) are those that are both required and jointly suffice to provide a complete description of the world. [Lewis (1986): 60]. The distribution of every other property supervenes on the distribution of the perfectly properties (and relations); the perfectly natural properties (and relations) are the minimal supervenience base of every world.[42]

Instance ties together the concepts of simplicity and naturalness. According to Instance, an object is a simple if and only if it *instantiates* a perfectly natural property.

There is an initial worry about Instance that I want to mention and then ignore. Recent work in the metaphysics of properties has caused a revival of interest in so-called bundle theories of particulars, according to which particulars are bundles of properties. There are two natural ways to understand the bundling relation: we can identify bundles with sets of properties or with mereological fusions of properties. If the bundle theory of particulars is true, then fundamental particles are not simples.

Instead, they have properties as parts. The best candidates for being simple on this view are the fundamental properties themselves.[43] This is an interesting worry about Instance, but, as I said, I want to table this worry. For we would need to resolve a long-standing debate between advocates of the bundle theory of particulars and defenders of the substance-attribute view of particulars in order to address this worry.[44] This would be a task too large for this chapter.[45]

Instance is a theory about the nature of material simples that is also in principle capable of answering the fully general Simple question, which is: under what circumstance is an entity (of any ontological category) a simple? As I discussed earlier, for any category of entity we care to include in our ontology, it makes sense to divide the entities in that category into those that are simple and those that are complex. Accordingly, it would be nice to have a unified and fully general account of what it is to be a simple *simpliciter*. Theories that characterize simples in terms of spatial (or spatiotemporal) concepts cannot provide a unified account of the nature of *all* simples. This is because not every entity has spatial or spatiotemporal features. Similar remarks apply to accounts that characterize simples in terms of indivisibility.

However, the concept of having a natural property is not a concept that necessarily applies only to material objects, for it is possible that there are natural properties that are had by non-physical objects. For example, certain psychological properties might be perfectly natural. (In fact, I hold that this is the case.) Cartesian spirits, which are paradigmatic examples of non-physical objects, could have these properties. Accordingly, Instance is in a better position to provide a unified account of simplicity than spatially based accounts. In this respect, Instance is superior to spatially based accounts like the Pointy View or MaxCon, or divisibility accounts.

The main case for Instance is based on the intuition had by many that the properties of wholes are strongly dependent on the properties and relations of their proper parts. For some properties of wholes, that there is this kind of dependence is obvious, e.g., the shape of a complex material object is fixed by the shapes of its parts and the spatial relations obtaining between those parts. But some people have the intuition that this kind of dependence holds for every intrinsic property of a whole. The following principle is a way of formally stating this kind of dependence:

> (PWD): For every object *x* and all objects *ys* such that *x* is the fusion of the *ys*, and for all worlds *w1* and *w2*, if each of the *ys* has the same intrinsic properties in *w1* as it has in *w2*, and the *ys* stand in the same relations to each other in *w1* as they do in *w2*, then *x* has intrinsic property *F* in *w1* if and only if *x* has *F* in *w2*.[46]

In other words, given PWD, a whole cannot enjoy intrinsic variation across possible worlds unless either one of its proper parts enjoys intrinsic variation across possible worlds or its proper parts change with respect to the relations that they bear to each other.

I will now argue that, if you like PWD, you have some reason to like Instance. My first premise is a Humean principle to the effect that there are no necessary connections between the instantiations of the perfectly natural properties of contingent beings.[47] For example, if (1) *x* is not identical with *y*, (2) *x* has *F* and *y* has *G*, (3) *x* and *y* are contingently existing material objects and (4) *F* and *G* are perfectly natural properties, then there is a possible world in which both *x* and *y* exist, but in which *x* has *F* and *y* does not have *G*. More generally, the instantiation of any perfectly natural property or relation by contingently existing beings is metaphysically independent of the instantiation of any perfectly natural property or relation by other contingent beings.

Suppose that there is a complex material object x that instantiates a perfectly natural property F. Because F is perfectly natural, its instantiation is independent of the instantiation of other perfectly natural properties (for the Humean reason just given). So there is a possible world in which all of x's proper parts have the same perfectly natural properties and stand in the same perfectly natural relations, but in which x does not instantiate F. Since F is perfectly natural, F is also an intrinsic property. Since x's proper parts all have the same perfectly natural properties and stand in the same perfectly natural relations to each other, all of x's parts have the same intrinsic properties. So there is a possible world in which all of x's proper parts have the same intrinsic properties and stand in the same relations as they do in the actual world, but in which x differs intrinsically. So our assumption that a complex object has a perfectly natural property has led us to the conclusion that PWD is false.

So, at the very least, there is an argument from PWD for the claim that instantiating a perfectly natural property is *sufficient* for being a simple. One can also produce an argument for the claim that having a perfectly natural property is *necessary* for being a simple. Its premises are straightforward. First, every object, whether simple or complex, must have some intrinsic properties. Suppose that a simple x has an intrinsic property P. Either P is itself a perfectly natural property, or it supervenes on the perfectly natural properties and relations had by objects that are not identical with x, or P supervenes on the perfectly natural properties had by x. If the first disjunct is true, then x has a perfectly natural property. The second disjunct cannot be true, for if it were, then P would not be an intrinsic property; P would be an extrinsic property.[48] This leaves the third disjunct. Obviously, if the third disjunct is true, then x has a perfectly natural property. So, if every material object must have some intrinsic properties, then having a perfectly natural property is necessary for being a simple. If we conjoin these two results, we arrive at Instance: an object is a simple if and only if it instantiates a perfectly natural property.

So an interesting case can be made for Instance. However, I reject the main principle employed in the arguments above. Specifically, I reject PWD. Moreover, my reason for rejecting PWD is also a reason for rejecting Instance.

I think that it is possible for mereologically complex objects to instantiate perfectly natural properties. I think this because I think that some mereologically complex objects actually instantiate perfectly natural properties. Specifically, I think that I am a mereologically complex material object who instantiates perfectly natural properties. I hold that certain mental properties, such as having a blue sensation or being in pain, are perfectly natural properties, or, at the very least, supervene on perfectly natural properties had by complex objects.

The argument that some phenomenal properties are perfectly natural is reasonably straightforward, but, of course, very controversial. The first premise is that there is a *zombie world.* A zombie world is a possible world that satisfies the following conditions: (1) every fundamental particle that exists in the actual world exists in the zombie world, (2) no fundamental particle exists in the zombie world that does not exist in the actual world, (3) every fundamental particle has the same intrinsic properties in the actual world as it has in the zombie world, (4) the fundamental particles stand in the same external relations to each other in the zombie world as they do in the actual world, and (5) nothing experiences episodes of phenomenal consciousness, such as having a blue sensation or feeling pain, in the zombie world.[49] I accept the first premise, because I seem able to conceive of a situation in which everything is just alike at the microscopic level, but in which no one enjoys qualitative experiences. (I also note that I am presupposing that every fundamental particle is a mereological simple and that there are no non-physical mereological simples such as Cartesian spirits.)

The second premise is that phenomenal properties are *intrinsic* properties. I do not know how to argue for this claim; it seems intuitive to me, although I acknowledge that there is some controversy about whether it is true.[50]

These two premises imply that PWD is false. If they are true, the case for Instance has been undercut. Moreover, when supplemented with a third premise, they provide a reason to reject Instance. The third premise is this: if zombie worlds are possible, and phenomenal properties are intrinsic properties, then phenomenal properties are perfectly natural properties or supervene on perfectly natural properties had by mereologically complex objects. Since phenomenal properties are had by complex wholes, these three premises imply the falsity of Instance.

Why believe the third premise? Recall that the distribution of every qualitative property supervenes on the distribution of the perfectly natural properties and relations. So there can't be two worlds that differ qualitatively without differing with respect to some perfectly natural property or relation. A zombie world is a world that differs qualitatively from our world. So it must differ with respect to some perfectly natural property or relation. But it does not differ with respect to any of the perfectly natural properties or relations that are instantiated by the fundamental particles. So it must differ with respect to the perfectly natural properties had by some composite object.[51] So some composite object in the actual world must have a perfectly natural property that is not had by a composite object in the zombie world. So a composite object in the actual world has a perfectly natural property. This state of affairs is a counter-example to Instance.

I have presupposed that mereologically complex material objects are the bearers of phenomenal properties. But one could maintain Instance if one rejected this claim. The existence of perfectly natural properties is not a problem for Instance if there exist mereological simples that instantiate them. In fact, one could argue for the existence of simple immaterial substances from the premises that (1) Instance is true, (2) being in pain is a perfectly natural property, (3) something is in pain, and (4) no material simple instantiates being in pain.

In general, Instance rules out the possibility of genuinely emergent properties. This is a reason to be concerned. Independently of concerns stemming from the philosophy of mind, it seems to me that we can conceive of situations in which perfectly natural properties are instantiated by mereologically complex objects. Suppose, for example, that physicists discover that bodies that appear to be particle-per-particle duplicates nevertheless behave differently when in the presence of a third kind of thing. That is, although A and B have the same sub-atomic structure, when in the presence of a third object clearly qualitatively different from A and B, effect E1 is produced when A is present, whereas effect E2 is produced when B is present. Suppose that these physicists observe a large number of instances of this occurring. From a microphysical perspective, all of these bodies appear to be duplicates. It is reasonable to think that something else accounts for the difference in their behavior.[52] So, since nothing yet discovered at the level of microphysics does, that difference must be a difference at the macrophysical level. Some bodies must have a feature that others lack. In this kind of case, scientists would be justified in postulating natural properties that are had by macrophysical wholes, not their parts. Instance rules this kind of case out *a priori*.

A second argument against Instance involves the possibility of co-located material objects. The argument is as follows: First, as I argued in section 2.2, co-located point-sized material objects are possible. Second, an object composed of two co-located point-sized objects is itself a point-sized object. This premise is obviously true.

Third, being point-sized is a perfectly natural property. This is controversial. Some philosophers think of points of space as a kind of logical or mathematical construction. On their view, points of space may be identified with sequences of nested spheres that "approach" them. In other words, on this view, points are limits of regions, not real parts of space. Accordingly, no material object can exactly occupy them. I take this worry seriously, but I can't address it here. So I will simply assume that being point-sized is a possible size for a material object to be and accordingly reject this reason for denying premise three.[53]

These premises straightforwardly imply that it is possible for a composite object to have a perfectly natural property. This in turn implies that Instance is false.

Unfortunately, I cannot accept this argument as it stands. I will argue in chapter three that the spatiotemporal properties of material objects are derivative of the spatiotemporal properties of the regions of spacetime they occupy. On this picture, *being point-sized* is a perfectly natural property of regions of spacetime. Objects are point-sized in virtue of *occupying* point-sized regions. The argument just given doesn't work if this picture is correct. However, the picture itself is controversial, and if it must be rejected, we can comfort ourselves by noting that we have a second argument against Instance.

A related worry stems from the fact that many, if not all, of the fundamental properties at the actual world are determinables.[54] For example, consider *mass*. It is reasonable to think that mass is a fundamental property. However, objects such as my body, this table, and the planet have mass. Should I conclude then that all of these things are simples? Clearly not.

Strictly speaking, I hold that it is the determinates of mass that are the best candidates for being perfectly natural. So perhaps this worry arises only if *some*, but not *all*, of the determinates of mass are perfectly natural. We could call these determinates *the fundamental quantities* of mass if we liked. If the fundamental quantities of mass are had only by physical simples, whereas the non-perfectly natural determinates of mass are had by complex material objects, then this particular version of the objection would be circumvented.

There are two problems with this maneuver. First, it is not certain whether there are fundamental quantities of mass in this sense. So this move is risky. Second, and more damaging, it seems that this sort of maneuver does not work in other cases. Consider, for example, *charge*. *Being –1 charged* is a fundamental quantity of charge if any is. An electron, which is arguably a simple, has a charge of –1. However, consider a negatively charged isotope that has a charge of –1 because it has an extra electron. It has a fundamental quantity of charge and hence instantiates a perfectly natural property. This isotope is clearly not a simple.[55]

Perhaps a way around this problem is to claim that the isotope has a charge of –1 *derivatively*, i.e., in virtue of the charge of its *parts*, and so on for the other quantities. Likewise, in some sense, I *inherit* the mass that I have from the mass of my parts; my mass is supervenient upon the mass of these objects, and likewise for the charge of the isotope. We could revise Instance so that it takes account of this intuition:

> **Instance*:** *x* is a simple if and only if *x* instantiates a perfectly natural property non-derivatively.

However, to say that an object has a property derivatively is to say that it has the property in virtue of its parts having that property. So Instance* is actually circular; it violates one of the constraints on being an answer to the Simple Question. (And, even if there is a way around this worry, Instance* would still face the previously discussed problems.)

Perhaps instead of moving to Instance*, the friend of Instance should instead distinguish the property of having a net charge of –1 from the property of having a charge of –1.[56] An object has a net charge of –1 just in case the sum of the quantities of charge of its proper parts is equal to –1. According to this strategy, the isotope has a net charge of –1 but it does not have the property of having a charge of –1. If this strategy is viable, this kind of counter-example to Instance fails. It's not clear to me, however, that the composite object does not have the property of having a charge of –1 as well as the property of having a net charge of –1. So I am unsure whether this move is successful. (And even if it is, Instance would still face the previously discussed objections.)

This completes my case against Instance. I will now discuss:

The Independence View of Simples (Independence): x is a simple if and only if it is metaphysically possible that x is the only material object that exists.

The idea that simples can be fully recombined finds its clearest statement in the work of D.M. Armstrong in *A Combinatorial Theory of Possibility*. In that book, Armstrong develops an account of modality that implies that any simple can coexist with any other simple. More relevantly, the theory developed there implies that, if something is a simple, then it is metaphysically possible for it to exist alone. [Armstrong (1989): 37-48, 61-62].

I endorse the Humean program in modal metaphysics, so I will not challenge the claim that, if something is a simple, then it is metaphysically possible that it is the only material object that exists. However, this is not to say that the claim will be acceptable to all. Many philosophers claim that objects have their *origins* essentially. Suppose that an electron was created as a result of the big bang. Suppose that the big bang would not have happened had there not been an initial singularity, i.e., a point-sized object of enormous density. If objects have their origins essentially, then our electron could not have existed unless that singularity also existed. But nevertheless the electron is still an excellent candidate for being a simple.

My first worry about Independence is that it seems that some composite objects could satisfy the right hand-side of the biconditional. For consider a composite object that could have been a simple.[57] If this object could have been a simple, then it, like other simples, could have been the only material object in existence.[58] But then it satisfies the right-hand side of the biconditional. But, since it is not actually a simple, Independence is false.

The advocate of Independence can avoid this worry by revising her view as follows:

> **Independence*:** x is a simple if and only if there is a possible world w at which (1) x is the only existing material object and (2) x instantiates an intrinsic property P at the actual world if and only if x instantiates P at w.

Independence* avoids the counter-example that plagued its ancestor. Perhaps a composite object could have been a simple. But any object has a different intrinsic character in worlds in which it is a simple than in worlds in which it is complex.

I am inclined to think that Independence* is true. I think that Independence* provides necessary and sufficient conditions for being a simple. My worry is that Independence* violates the non-circularity requirement on being an answer to the Simple Question. Independence* appeals to the notion of an intrinsic property, and this concept is partly mereological. Recall the definition of "intrinsic property": a property is intrinsic if and only if it never differs between duplicates. Now recall that the analysis of duplication also appealed to the concept of parthood: x and y are duplicates if and only if there is a 1-1 correspondence between their *parts* that preserves perfectly natural properties and relations. So Independence* may provide necessary and sufficient conditions for being a simple, but Independence* is consistent with the Brutal View.[59]

This completes my case against Independence.

2.5 Indivisibility Accounts of Simplicity

As the name suggests, Indivisibility accounts appeal to the concept of *indivisibility* when answering the Simple Question. Markosian distinguishes two accounts, which he calls:

The Physically Indivisible View of Simples (PIV): x is a simple if and only if it is not physically possible to divide x.

The (Revised) Metaphysically Indivisible View of Simples (MIV): x is a simple if and only if it is not metaphysically possible to divide x without first changing x's intrinsic properties. [Markosian (1998a): 220-221].[60]

My first worry about the Indivisibility accounts is that they appear to violate the non-circularity condition on being an answer to the Simple Question. It seems that the concept of divisibility cannot be explicated without appealing to mereological concepts in the explication. Consider the following analysis of *divisibility*:

> (D1): x is *divisible* if and only if it is possible that there are objects y and z such that (1) x is composed of y and z and (2) the union of the regions occupied by y and z is discontinuous.

D1 has two interesting features. First, it does not imply that divisible objects have proper parts, but it does imply that divisible objects possibly have proper parts. Second, D1 implies that divisible objects can survive division. A different account of divisibility that does not have these features is:

> (D2): x is divisible if and only if there are objects y and z such that (1) x is composed of y and z and (2) it is possible that the union of the regions occupied by y and z is discontinuous.

D2 implies that divisible objects have proper parts, but it does not imply that divisible objects can survive division.

Notice that both accounts of divisibility employ mereological concepts. So any account of simplicity that employs the concept of divisibility and then explicates this concept along the lines of D1 or D2 violates one of the conditions on being an answer to the Simple Question by appealing to mereological concepts in the right-hand side of the answer.[61] Without a non-circular account of *divisibility*, the divisibility accounts are not competitors to the Brutal View.

Second, the physical divisibility account seems to be a non-starter. My primary worry stems from the fact that *being physically indivisible* seems to be an *extrinsic* property. An object might be physically indivisible in world w and yet be physically divisible in a world with different natural laws. Yet that object may have the same intrinsic nature in both worlds.

But *being a simple* is not an extrinsic property. It is provably an intrinsic property. Suppose that x and y are duplicates and that x is a simple. Since x and y are duplicates, there is a 1-1 correspondence between their parts that preserves perfectly natural properties. But then there is a 1-1 correspondence between their parts. So y is a simple. So simplicity is preserved by duplication. So being a simple is an intrinsic property.

If two properties are necessarily co-extensive, then one of them is an intrinsic property if and only if the other property is. *Proof*: assume P and Q are necessarily co-extensive. Then P never differs between duplicates if and only if Q never differs between duplicates. Intrinsic properties are properties that never differ between duplicates. So P is intrinsic if and only if Q is intrinsic.

Since *being physically indivisible* is an *extrinsic property* and *being a simple* is an intrinsic property, and since it is impossible for an extrinsic property to be necessarily co-extensive with an intrinsic property, PIV is false.

I will now discuss the Revised Metaphysically Indivisible View of Simples. Markosian writes this about MIV:

> Unfortunately, [MIV] is equivalent to the Pointy View of Simples. For it seems clear that all and only pointy objects would satisfy the right-hand side of the bi-conditional.... Thus the above objections to the Pointy View of Simples would also apply equally well against this view. [Markosian (1998a): 221].

I think that this is mistaken, although it is hard to tell, since we do not have a clear account of the notion of metaphysical divisibility. However, even if we operate only with intuitive grasp of this concept, I think we agree that some possible point-sized objects are metaphysically divisible. Consider a point-sized object that is composed of two other point-sized objects. (I argued that this kind of case is possible in section 2.2.) This object seems to be divisible, for it is possible for its parts to be in distinct regions of space. The Pointy View incorrectly implies that this object is a simple; MIV does not have this implication. MIV and the Pointy View are not equivalent.[62]

So Markosian's reason for rejecting MIV doesn't work. Nonetheless, I think there are good reasons to reject MIV. My first worry is that MIV faces the circularity worry in a second guise. In addition to appealing to the concept of divisibility, MIV also appeals to the concept of an intrinsic property. And this concept is partly mereological, as I argued in the previous section. So MIV is guilty twice-over of sneaking mereological concepts into the analysis of simplicity.

This completes my case against MIV.

2.6 Arguments Against the Brutal View of Simples

I have presented a lengthy argument for the Brutal View of Simples, based on the fact that its rivals face serious objections. Here, I present, discuss, and defeat arguments against the Brutal View. This will complete my defense of the Brutal View.

2.6.1 Unacceptably Fragile Simples?

In a recent paper titled "Borderline Simple or Extremely Simple?", Kathryn Hawley presents an argument designed to show that anyone who rejects a moderate answer to the Special Composition Question also should reject a moderate answer to the Simple Question.[63]

I endorse *compositional universalism* according to which, necessarily, every collection of objects composes a whole. Compositional universalism is a non-moderate answer to the Special Composition Question. However, the Brutal View *is* a moderate answer to the Simple Question. If Hawley's argument succeeds, I will have some reason to abandon one of these views.

Let us say that a *moderate answer to the Special Composition Question* is an answer to that question that implies that there are situations in which some objects compose a whole and there are situations in which some objects do not compose a whole. Similarly, let us say that a *moderate answer to the Simple Question* is an answer to that question that implies that some possible objects are simples and some possible objects are not. The Brutal View is a moderate response to the Simple Question; strictly speaking, the Brutal View is not an *answer* to the Simple Question, since it is not of the right form to count as an answer. But it is nonetheless a view that implies that some possible objects are simples and some possible objects are not simples.[64]

Many philosophers reject moderate answers to the Special Composition Question because they hold that any such answer will imply that it is sometimes a vague matter whether a particular thing exists. Accordingly, these philosophers endorse an *extreme* answer to the Special Composition Question. The two extreme answers to the Special Composition Question are *compositional nihilism*, according to which composition never occurs, and *compositional universalism*, according to which any collection of objects composes a whole.[65]

A third response is to deny that the Special Composition Question has an informative answer. According to this response, there is no finitely stateable, non-trivial answer to the Special Composition Question. This view, which has been developed and defended by Ned Markosian, is called *the Brutal View of Composition.* [Markosian (1998b)]. The Brutal View of Simples is formally analogous to the Brutal View of Composition, and was in fact inspired by this latter view.

In her forthcoming paper, "Borderline Simple or Extremely Simple?", Hawley argues that anyone who rejects a moderate answer to the composition question because of concerns about vagueness in existence should also reject moderate answers to the Simple Question.[Hawley (forthcoming)]. In a similar vein, she argues that anyone who rejects the Brutal View of Composition should also reject the Brutal View of Simples.

Since I accept an extreme answer to the Special Composition Question, namely compositional universalism, but embrace the Brutal View of Simples, Hawley's argument is especially worrisome. Fortunately, I believe that the argument can be resisted. I will argue first that the argument presented against the Brutal View of Composition is not persuasive. So, even if Hawley is right that anyone who rejects the

Brutal View of Composition for the reason she gives should also reject the Brutal View of Simples for similar reasons, no one should reject the Brutal View of Composition for these reasons.

The bulk of Hawley's argument appears in the following passages:

> If simplicity is brute, then there could be two extremely similar objects which differed in whether or not they had proper parts. If this seems objectionable, then, as in the case of composition, it is perhaps because it makes existence seems unbearably fragile: if this object had been ever so slightly different then its proper parts just would not have existed, and if this plurality had been ever so slightly different, then its sum just would not have existed (other things being equal, that is). *Prima facie*, this fragility concern seems to apply symmetrically to brute composition and to brute simplicity. [Hawley (forthcoming): 7].

My reconstruction of Hawley's argument is this:

(1) If the Brutal View of Simples is true, then it is possible for there to be a simple object and a composite object that are extremely similar to each other.

(2) It is not possible for there to be a simple object and a composite object that are extremely similar to each other.

(3) So the Brutal View of Simples is not true.

Hawley's argument is valid. Let us turn to the premises.

The first issue that arises is that it is not obvious whether mereological simples can be extremely similar to mereologically complex objects. The notion of "extreme similarity" is very fluid. In some contexts, one might be willing to say that a rhino is extremely similar to a hippo. In other contexts, one might not be willing to say this. We need to understand what standards we are to employ when assessing premises that invoke the notion of extreme similarity.

To see how fluid this notion really can be, consider the following case. Consider a mereologically complex object *o1* that is composed of two mereological simples. Although the region of space *R1* exactly occupied by *o1* is a discontinuous region, the two proper parts of *O1* are very, very close to each other in space. Both parts occupy open regions of space and are separated by nothing more than a two-dimensional plane. In short, the distance between the two simple parts of *O1* is zero, although the region of space *R1* that *O1* exactly occupies is not continuous. *R1* is an almost-spherical region of space with a radius of one millimeter. Let us say that each of *O1*'s parts has 5 grams of mass and no other interesting features and let us also say that *O1* has 10 grams of mass in virtue of this fact.

Consider now *O2*. *O2* is an extended simple that exactly occupies a continuous region of space *R2*. *R2* is also a spherical region of space with a radius of one millimeter. *O2* has 10 grams of mass and no other perfectly natural properties.

Despite the fact that *O1* is a complex object and *O2* is a simple, I think that in some contexts we would be willing to say that these two objects are extremely similar. Is this the kind of context that Hawley is invoking?

Let us note that the Brutal View of Simples does not imply that this case is impossible. The Brutal View of Simples also does not imply that it is possible. More interestingly, other views of simples seem to imply that this case is possible. Consider, for example, MaxCon. Recall that, according to MaxCon, something is a simple just in case it exactly occupies a maximally continuous matter-filled region of space. MaxCon implies that the thought experiment just discussed is possible. So, if *O1* and *O2* count as being extremely similar to each other, the MaxConist must hold that it is possible for a simple to be "extremely similar" to a complex object. The MaxConist should not find the argument against the Brutal View of Simples persuasive, since he must reject the second premise of the argument, if we are invoking the intended notion of extreme similarity. (If we are not invoking the intended notion of extreme similarity, then we need to be told by Hawley what that standard is.)

Perhaps the advocates of other theories also should reject premise (2). Let us consider the *Pointy View*, according to which an object is a simple just in case it is point-sized. Consider a continuous series of objects, *a* ..... *b*, such that every object in the series is slightly smaller in size and less massive than its predecessor. *a* is extremely small; *a* is enjoys 1 millimeter of length. *b* is point-sized. Let us assume that the mass of the objects in the series is a function of its length: mass(x) in milligrams = length(x) in millimeters plus 10^-10. Accordingly, *b* enjoys 10^-10 units of mass. Perhaps *b* is extremely similar to some of its predecessors in this series. If this is the case, then the advocate of the Pointy View of Simples should also reject premise (2).

I suspect that this is true of many of the other plausible theories concerning the nature of simples. So premise (2) seems to be an ineffective weapon against the Brutal View of Simples, at least when wielded by the advocate of MaxCon or the Pointy View. For on at least some reasonable interpretations of "extreme similarity," the advocates of these positions must reject premise (2) as well.

Of course, it is possible that I have been employing standards for being extremely similar that are laxer than those that Hawley employs. If this is the case, we need to know what Hawley's standards are.

Why does Hawley endorse (1)? Why does she think the friend of the Brutal View must say that there is some pair of possible objects such that, although they are extremely similar to each other, one is a simple and one is not? The Brutal View of Simples does not imply that (1) is true in any straightforward way.

How could rejecting (1) land the friend of the Brutal View of Simples in trouble? Perhaps Hawley holds the following claim:

> (LINK): For any two possible objects *o1* and *o2*, there is an ordered tuple of possible objects **O** such that:
>
> (i) *o1* is the first member of **O**,
>
> (ii) *o2* is the last member of **O**,
>
> (iii) every element of **O** is extremely similar to its predecessor in the series.

Suppose LINK is true. Suppose the Brutal View of Simples is true. Suppose (1) is false. We can now derive a contradiction. (We will hold fixed some interpretation of "extreme similarity" throughout this argument.) Since the Brutal View of Simples is true, there are some possible objects that are simples and some possible objects that are complex. Call the possible simple *S* and the possible complex object C. Given LINK, there is a series of objects beginning with *S* and terminating with *C*. Each element in the series is extremely similar to its predecessor. Since we are rejecting (1), an element in the series is a simple if and only if its predecessor is a simple. But then every element in the series is a complex object. But then *S* is a complex object. We have successfully derived a contradiction. One way to get out of the contradiction is to endorse (1) instead of rejecting (1). Perhaps this is Hawley's rationale for (1). (It is hard to tell from the text.)

But why endorse LINK? Suppose you have two simples *x* and *y*. *x* enjoys mass but has no other perfectly natural properties. *y* enjoys the perfectly natural *ninj* but has no other perfectly natural properties. What chain of "extremely similar" objects could link them together? It is hard to see what it could be like.

I conclude that Hawley's argument against the Brutal View of Simples fails.

2.6.2 Unknowable Simples?

A commonly told tale goes something like this: we used to think that chemical atoms were also atoms in the original sense, i.e., mereological simples. But then we discovered that atoms are not mereological simples: we discovered that atoms are composed of a nucleus and the electrons in the outer-shells surrounding the atom. Perhaps there is further structure yet to be discovered? As Jonathan Schaffer writes:

> Indeed, the history of science is a history of finding ever-deeper structure. We have gone from "the elements" to "the atoms" (etymology is revealing), to the subatomic electrons, protons, and neutrons, to the zoo of "elementary particles," to thinking that hadrons are built out of quarks, and now we are sometimes promised that these entities are really strings, while some hypothesize that the quarks are built out of preons (in order to explain why quarks come in families). Should one not expect the future to be like the past? [Schaffer (2003b): 503].

There are two related worries that this picture seems to generate for the Brutal View. First, it seems that we often discover that certain objects are not simple. We might worry that, if the Brutal View of Simples is true, then we could not discover whether these objects were simple. What criterion could we use to rule that some object is not a simple if the Brutal View of Simples is true?

Second, it seems as if the search for the fundamental physical objects, by which I mean material mereological atoms, is one of the large projects in the history of physics. But it is hard to see how we could hope to succeed in this endeavor – *even if the world does divide without remainder into mereological atoms* – if the Brutal View of Simples is true.

Many answers to the Simple Question do not face these worries. For example, consider MaxCon. We have discovered that the nucleus of, e.g., a hydrogen atom is actually some distance apart from the electron. This means that a hydrogen atom is not a maximally continuous object. So MaxCon correctly implies that a hydrogen atom is not a simple. Moreover, MaxCon can guide us in our search for the fundamental level: if we wish to find out which objects are mereological atoms, we should find out which objects are maximally continuous.

Similarly, the Pointy View can guide us in our search for the fundamental level: if we wish to find out which objects are mereological atoms, we should find out which objects are point-sized. Many of the other answers to the Simple Question seem to have this feature as well. Instance, for example, implies that the fundamental physical objects are also the basic bearers of perfectly natural properties. So, once we discover those properties on which all else supervenes, we will have discovered the true atoms of the world as well.

But it seems that the Brutal View of Simples cannot provide any guidance in our search. How then, given the Brutal View of Simples, could we ever know that our search had come to a conclusion? Perhaps some objects really are the true elements of the world. But the Brutal View of Simples won't tell us that they are. How then could we know that they are? We might be tempted to say that discovering what objects are the actual mereological simples is the job of scientists, not philosophers, but without some idea of what they are looking for, how will they know when they have found it?

It is true that the Brutal View of Simples does not provide this sort of guidance. But this does not mean that the Brutal View of Simples is inconsistent with other principles that could provide us with aid in our quest to discover the true atoms of the world. As I noted in the previous chapter, the Brutal View of Simples is consistent with the existence of necessary conditions on being a simple, provided that these conditions are not both sufficient and informative. Similarly, it is consistent with the Brutal View of Simples that there are sufficient conditions for being a simple; as long as these sufficient conditions are not both also necessary and informative, the advocate of the Brutal View of Simples need not do without them.

In the next chapter, I will discuss one informative necessary condition for being a simple: lack of qualitative heterogeneity. This necessary condition eliminates potential candidates for being simples, but this condition is completely consistent with the Brutal View. It is possible that we will be able to discover other conditions as well that will aid us with our search. The Brutal View's failure to do this work does not reflect poorly on it.

2.7 Closing Remarks

The Brutal View is a somewhat unsatisfying answer to the Simple Question. But, if the most plausible alternatives to the Brutal View fail, a reasonable hypothesis why they fail is that simples *per se* have no nature.

Many of the premises employed in the arguments against the Brutal View's rivals are controversial. And, since the direct argument for the Brutal View is an argument via elimination, the case for the Brutal View is somewhat shaky. Specifically, I am aware that some of the modal principles I cherish and employ throughout this chapter – specifically, recombination principles conceived in a broadly Humean spirit – are not cherished by all.

In the closing remarks of the paper in which he first raised the Simple Question, Markosian makes this observation:

> Many of the above reasons in support of MaxCon, as well as the arguments I have given against MaxCon's rivals, are based on appeals to intuitions about what should be said concerning various possible cases. Such "modal intuitions" are notoriously difficult to defend. I understand that many philosophers who read this paper will not be convinced by my arguments, precisely because they do not share my modal intuitions about the relevant cases. But this is a common phenomenon, especially in discussions of fundamental metaphysical issues, and it would be a mistake to expect anything else. I hope that the arguments of the paper will nevertheless be valuable even to those who do not share my modal intuitions. For it can be worthwhile to see what there is to be said for a given view, and what are the consequences of that view, even if one does not share the intuitions that motivate the view. [Markosian (1998a): 227].

I do not share Markosian's modal intuitions. But I share his sentiments about the value of arguments that employ modal intuitions. Although arguments employing them will not persuade those who do not share them, it is worthwhile to see how far these views can be pushed.

Second, since the case for the Brutal View is an argument via elimination, I must acknowledge the possibility that I have failed to consider other possible answers to the Simple Question. My only defence is that I am unable to think of what they might be. I would be happy if someone else is able to produce a new plausible answer to the Simple Question. As Markosian noted, the Simple Question deserves more attention.

Notes

[1] The Simple Question was first raised by Ned Markosian in Markosian (1998a).

[2] The Special Composition Question was first raised by Peter van Inwagen in van Inwagen (1990a).

[3] The name "Nihilism" was coined by Peter van Inwagen in van Inwagen (1990): 72-74.

[4] Strictly speaking, this is a consequence of Nihilism only given certain facts about the actual world. It is a fact about the actual world that, if there are tables, chairs, etc., then these objects have parts.

[5] Friends of extended simples include Ned Markosian [Markosian (1998a)], Neil McKinnon [McKinnon (forthcoming)], Josh Parsons [Parsons (2000)], Mark Scala [Scala (2002)], and Theodore Sider [Sider (forthcoming)].

[6] Here is the quote from Newton's *Opticks* that Scala discusses: "It seems probable to me that God in the Beginning formed Matter in solid, massy, hard, impenetrable moveable Particles, of such Sizes and Figures, and with such other Properties; and in proportion to space, as most conduced to the end for which he formed them; and as these primitive Particles being Solids, are incomparably harder than any porous Bodies compounded out of them; even so very hard as never to wear or break in pieces; no ordinary Power being able to divide what God himself made in one first creation."

[7] The Brutal View is inspired by a related view that answers the Special Composition Question: the Brutal View of Composition. On this intriguing position, see Markosian (1998b). I discuss the Brutal View of Composition in section 2.6.

[8] I thank Ben Caplan and Cody Gilmore for helpful discussion on this point.

[9] Markosian also presents several arguments against the Pointy View in Markosian (1998a): 216-219.

[10] MaxCon is the view that Markosian endorses in Markosian (1998a). Markosian employs the following definitions in the explication of his view:

1. Object O *occupies* region R $=_{df}$ R is the set containing all and only those points that lie within O.

2. *O* is *spatially continuous* iff *O* occupies a continuous region of space.

3. R is *continuous* $=_{df}$ R is not discontinuous.

4. R is *discontinuous* $=_{df}$ R is the union of two non-null separated regions.

5. R and R' are *separated* $=_{df}$ the intersection of either R or R' with the closure of the other is null.

6. The *closure* of R $=_{df}$ the union of R with the set of all its boundary points.

7. p is a *boundary point* of R $=_{df}$ every open sphere about p has a non-null intersection with both R and the complement of R.

8. R is an *open sphere* about p $=_{df}$ the members of R are all and only those points that are less than some fixed distance from p.

9. The *complement* of R $=_{df}$ the set of points in space not in R.

10. *x* is a *maximally continuous object* $=_{df}$ *x* is a spatially continuous object and there is no continuous region of space, R, such that (i) the region occupied by *x* is a proper subset of R, and (ii) every point in R falls within some object or other.

Markosian borrows (2)-(9) from [Cartwright 1987]. (Richard Cartwright uses "connected" and "disconnected" instead of "continuous" and "discontinuous.")

[11] More cautiously, MaxCon does not imply that there are restrictions on the shape or size of extended simples. There might be other restrictions on the shape or size of material objects that are consistent with MaxCon.

[12] Hudson argues this in Hudson (2001):84-87.

[13] And only one of the spatial accounts is plausibly when applied to regions of spacetime. The Pointy View seems to accurately account for when spatiotemporal regions are simples. MaxCon, on the other hand, is incorrect, for it implies that if spacetime is continuous, it is one big extended simple.

[14] Markosian explicitly states that the question that he is interested in the question of what makes a material object a simple. See Markosian (1998a): 214, footnote 10.

[15] I thank Ryan Wasserman for pressing me on this point. See [Wasserman (forthcoming)] where he also discusses this objection. Markosian acknowledges this worry, which he credits to Theodore Sider. See Markosian (1998a): 217, footnote 20.

[16] Two points should be stressed. First, co-location in this sense must be distinguished from complete mereological overlap. Two objects completely overlap each other if and only if the two objects have exactly the same parts. Second, regions and material objects form distinct ontological categories. If we drop this assumption, the argument from co-location is undercut. There is no way to make sense of co-located regions of spacetime. I think that this is a reason to reject the reduction of material objects to spacetime regions, but others may differ. I thank Carl Matheson for helpful discussion of this point.

[17] Since MaxCon implies that any point-sized material object is a simple, the possibility of mereologically complex point-sized objects also refutes MaxCon.

[18] For example, David Lewis writes:

> Wherever there is a charged particle, there the universal of charge, or else one of the topes of charge, is present. It is located there, just as the particle itself is. Indeed, it is part of the particle. ... If there are universals, we can say that the particle is composed partly of its several universals. ... We can say that the particle consists of its universals together with something else, something non-recurrent, that gives it its particularity. [Lewis (1986a): 64-65].

[19] Perhaps this is a defeasible reason, if conceivability does not entail metaphysical possibility. But, nonetheless, it does provide us with (as of yet undefeated) evidence that they are possible. On the relation between conceivability and possibility, see the fine collection of papers published in Gendler (2002).

[20] For interesting discussions about this issue and the question of whether bosons violate the Identity of Indiscernibles, see Cortes (1976), Barnette (1978), Ginsberg (1981), and Teller (1983).

[21] I have emphasized the relevant part of the quote; also, in the original passage, Simons talks about tropes, whereas I have substituted the word "property" for "trope" uniformly. I don't think this change makes a difference in this context.

[22] In response to this argument, David Robb suggested to me that a Humean could say that it is analytic that material objects do not interpenetrate; co-located objects are by definition not material objects. If co-located material objects are impossible for this reason, we still need to explain why they seem to be conceivable. Perhaps what we are envisioning is what David Robb called *phony matter*: non-material objects that have the same effects on our sensory states as do material objects. I think this suggestion won't work, for *material object* is an ontological category. If *x* belongs to an ontological category *C*, then *x* has the *intrinsic* property *being a C-entity*. So every duplicate of a material object is itself a material object. But our allegedly co-located material objects are duplicates of genuine material objects. So they themselves are material objects. So it is not analytic that material objects cannot interpenetrate.

[23] For defenses of these principles, see Armstrong (1989), Armstrong (1997): 148-184, and Lewis (1986).

[24] Note that, if composition is unrestricted, then we do not need the additional supposition that the co-located objects are bonded in order to ensure that they form a composite object.

[25] I thank Ben Caplan for stressing this point.

[26] I ignore *presentist* versions of 3Dism, according to which there is no need to index parthood and instantiation to times. On presentism and persistence, see Hinchliff (1996).

[27] I owe this suggestion to Hud Hudson.

[28] I thank Ted Sider for help with this section.

[29] Let us assume that both A and B have a topologically open and a topologically closed side. Perhaps the open face of A comes into contact with the closed face of B.

[30] Consider A. Given that the region occupied by A is not a maximally continuous region, it must have proper parts. Now consider any proper part of A; it also does not occupy a maximally continuous region, so it also must have proper parts. How can bringing two simples into contact create an infinity of material objects?

[31] We might worry that, once the MaxConist accepts arbitrary portions of matter, the notion of an object becomes simply an honorific bestowed on certain portions of matter. (This seems to be Michael Jubien's view; see Jubien (1993) for details.) So it is important to note that the MaxConist holds that *matter* and *material object* are different ontological categories. A material object, on this view, is not identical with the matter that resides in the region it occupies.

[32] See Markosian (1998a): 223-226. Cody Gilmore argues in Gilmore (forthcoming) that no plausible account of the nature of matter can be of use to the MaxConist in solving this problem.

[33] See Markosian (1998a):225, footnote #27.

[34] The advocate of this strategy should probably introduce polyadic instantiation-at-R relations as well, since extended simples can, I assume, stand in relations to other objects at various regions as well as have-at-a-region properties. Alternatively, the advocate of this strategy could embrace a multigrade instantiation-at-a-region relation. This strategy is inspired by Johnston (1987).

[35] Recall that, in the case I described, the properties that I called "redness" and "blueness" are fundamental intrinsic properties. So it's no fair for the relationalist to say that they were really relations all along. This move is tantamount to saying that every apparent intrinsic property of an extended simple is really just a relation to a region. I find this unacceptable.

[36] In fact, I advocate a similar strategy in the next chapter in order to save extended simples from certain objections.

[37] Let us say that the shape of an object includes all of its geometrical properties. Accordingly, the size of an object is a part of its shape.

[38] I am happy to grant that there are worlds in which this does happen and in which it happens to extended simples.

[39] For the most part, I ignore questions concerning the nature of the properties in what follows, such as whether the properties are repeatable *universals* or are themselves particulars, i.e., tropes. On the issue of tropes vs. universals, see Lewis (1997b) and Simons (1994).

[40] On naturalness in Lewis's sense, see Lewis (1997a), Lewis (1997b), Lewis (1986): 60-61, Schaffer (forthcoming), Sider (2001), and Sider (1995).

[41] More generally, since objective similarity also comes in degrees, the degree to which a given property is natural is independent of our beliefs, desires, or interests.

[42] The fundamental qualitative properties I discussed in section 2.2 form a subset of the perfectly natural properties.

[43] For arguments that the most plausible versions of the bundle theory of particulars are those in which only perfectly properties and relations are elements of the bundles that constitute particulars, see Armstrong (1997): 115-116 and Lewis (1997b). A version of the bundle theory that is consistent with Fundamental is developed in McDaniel (2001).

[44] According to the Substance-Attribute view, there is more to a particular than its properties; there is also the *substance* in which these properties inhere. Ordinary objects might be identified with the fusions of their properties and the substances in which they inhere. Alternatively, one might argue that ordinary objects do not have their properties as parts; instead ordinary objects are the substances that instantiate the properties. We need not settle this dispute here, for regardless of how it is settled, we need a criterion to determine when a substance is a simple substance or a complex substance. Instance provides this: a *substance* is a simple if and only if it instantiates a fundamental monadic property.

[45] For arguments against the bundle theory of particulars, see Armstrong (1997): 96-99 and Hawthorne (2002).

[46] When I speak of relations here, I mean *external* relations.

[47] See Armstrong (1989) and Armstrong (1997).

[48] Since x is a simple, any object to which x bears a relation is not a proper part of x.

[49] On the possibility of zombies, see Chalmers (1996): 94-99. I note that the defender of the irreducibility of phenomenal properties to physical properties need not reject Instance, if she is willing to embrace a form of *panpsychism*, according to which phenomenal properties supervene on *proto-psychical* properties. For more on this interesting issue, see Chalmers (1996): 26-127.

[50] On this issue, see Merricks (2003) and Sider (2003).

[51] Strictly speaking, there is another alternative: the worlds may differ with respect to some perfectly natural relation instantiated by composite objects, upon which the phenomenal properties supervene. These composite objects would have to be parts of the objects that have the phenomenal properties on pain of these properties being extrinsic. On this alternative, zombie worlds do not provide a counter-example to Instance. However, I suspect that anyone who takes the possibility of zombies seriously will not be tempted by this alternative.

[52] Although perhaps we are not required to think this. An alternative explanation is that the laws of nature at this world are indeterministic. (I thank C.L. Hardin for bringing this point to my attention). Of course, we are not required to think this either. My point is that there are possible situations in which one is justified in positing genuinely emergent properties.

[53] Suppose the advocate of Instance rejects the third premise of my argument for the reason just described. Then the advocate of Instance must hold that either (1) no perfectly natural properties are instantiated or (2) there are extended simples. If a perfectly natural property is instantiated in a world without points, then it is instantiated by an extended object. Either that extended object has parts, or it does not. If it has parts, then Instance is false. So, given Instance, if a perfectly natural property is instantiated, it must be instantiated by an extended simple.

[54] I thank Jonathan Schaffer for the following argument.

[55] A third worry is that this move seems to violate an intuitive principle governing determinates and determinables: *p* and *q* are determinates of the same determinable *only if p* and *q* are equally natural properties.

[56] I owe this suggestion to Phillip Bricker.

[57] Markosian discusses the inverse of this, specifically, the possibility that a simple become a composite in Markosian (1998a): 221. Admittedly, it is controversial whether these alleged possibilities are genuine. For example, mereological essentialists will deny that these possibilities are genuine.

[58] I assume here a modal logic at least as strong as S4.

[59] It is worthwhile to see a second attempt to salvage Independence. Consider *Independence***, according to which an object *x* is a simple if and only if there is a possible world *w* at which (1) *x* is the only existing material object and (2) *x* instantiates a perfectly natural *P* at the actual world if and only if *x* instantiates *P* at *w*. (This version was suggested to me by Ben Caplan.)

Since the concept of a perfectly natural property is not a mereological concept, Independence** is not circular. However, I think we can construct a possible counterexample to Independence**. Consider a possible world *w* in which a composite object *o* does not instantiate any perfectly natural properties. Suppose that *o* could have been a simple such that for any property *p* it instantiates, there is a property *q* such that *q* is more natural than *p*. In such a world, *o* does not instantiate a perfectly natural property either. If such a case is possible, then Independence** implies that *o* is actually a simple, which is false.

[60] Markosian also discusses an unrevised version of MIV; since I believe the argument he makes against it is sound, I will not discuss it here.

[61] Perhaps we could appeal to the concept of *matter* when giving an account of divisibility. (Markosian argues that the MaxConist needs to appeal to the persistence of matter in order to account for the qualitative heterogeneity of extended simples in Markosian (1998a): 223-226. Perhaps the advocate of the indivisibility accounts should as well.) Consider the following account of divisibility:

> (DM): x is divisible if and only if there is some matter M such that M "makes up" x and it is possible that M occupies a discontinuous region.

I reject DM because I hold that talk about matter is reducible to talk about things; see McDaniel (2003a) and the Introduction. DM either collapses to D1 or D2, or DM is incoherent.

[62] This example also shows that it is not the case that something is divisible if and only if it is extended in space.

[63] See Hawley (forthcoming).

[64] Suppose that, necessarily, every object is a simple. Then there is a finitely stateable and non-trivial answer to the Simple Question: necessarily, x is a simple iff x exists. Suppose that, necessarily, no object is a simple. Then there is a finitely stateble and non-trivial answer to the Simple Question: necessarily, x is a simple iff x is not self-identical. The Brutal View of Simples says that there is no finitely stateable and non-trivial answer to the Simple Question, and hence implies that some possible objects are simples and some possible objects are not simples.

[65] See Rosen (2003) for a defense of compositional nihilism.

CHAPTER 3

A DEFENSE OF EXTENDED SIMPLES

An extended simple is an object that occupies a larger than point-sized connected region of space (or spacetime) and yet has no proper parts.[1] Here I argue that we should take the possibility of extended simples seriously, identify three challenges that the advocate of extended simples faces, and present a solution that dissolves each of the three challenges.

The three challenges are as follows. First, there is the worry that any extended object must have parts. Second, there is the worry that, if extended and yet simple material objects are possible, then extended and yet simple regions of space are also possible. Finally, there is the worry that, if extended simples are possible, then a plausible principle of recombination is subject to counter-examples. I discuss in detail these challenges in section 3.2.

Although these challenges are distinct, I believe they can be met by a single solution. Briefly, the solution involves distinguishing two kinds of shape properties: *intrinsic* and *extrinsic* shapes. The solution is to hold that the shapes of extended simples are extrinsic. I present this solution in section 3.3 and apply it in sections 3.4-3.6.

3.1 Extended Simples

Why worry about the possibility of extended simples? First, speculation about the possibility of extended simples is not confined to philosophy. In a recent article, Mark Scala presents some evidence that Isaac Newton believed that the fundamental objects of this world are extended simples. Here is the quotation from Newton's *Opticks* that Scala discusses:

> It seems probable to me that God in the Beginning formed Matter in solid, massy, hard, impenetrable moveable Particles, of such Sizes and Figures, and with such other Properties; and in proportion to space, as most conduced to the end for which he formed them; and as these primitive Particles being Solids, are incomparably harder than any porous Bodies compounded out of them; even so very hard as never to wear or break in pieces; no ordinary Power being able to divide what God himself made in one first creation. [Scala (2002): 394].

And, more recently, in a popular book on string theory, the physicist Brian Greene seriously entertains this hypothesis as well:

> What are strings made of? There are two possible answers to this question. First, strings are truly fundamental – they are "atoms," uncuttable constituents, in the truest sense of the ancient Greeks. As the absolute smallest constituents of everything, they represent the end of the line.... From this perspective, even though strings have spatial extent, the question of their composition is without any content. Were strings to be made of something smaller, they would not be fundamental. [Greene (1999): 141].

So extended simples have played a role in a fundamental physical theory and might once again play such a role. Surely, if something plays a role in a fundamental physical theory, that provides a (possibly defeasible) reason to think that it is metaphysically possible. Although we no longer believe that the spacetime of the actual world is Newtonian, the fact that absolute simultaneity played a key role in previous physics certainly provides us with evidence that there are possible worlds in which absolute simultaneity is well defined. Even if we were to discover tomorrow that the actual world is really governed by causally deterministic laws, we would not relinquish the claim that an indeterministic world is a real metaphysical possibility. The fact that extended simples have been taken seriously by the theories of fundamental physics likewise provides a (possibly defeasible) reason to believe that they are possible.

Second, certain philosophical theories about the nature of simples imply the possibility of extended simples, and other theories about the nature of simples at least do not eliminate this possibility. An example of the first kind of theory is the *Maximally Continuous View of Simples* (MaxCon), according to which an object is a simple if and only if it fills a continuous region of space that is not a proper sub-region of a larger continuous matter-filled region of space. MaxCon implies that extended simples are possible, since continuous matter-filled regions of space (that are not subregions of some larger continuous matter-filled region of space) are clearly possible. An example of the second kind of theory is the *Brutal View of Simples*, according to which there is no non-mereological criterion for being a simple. The Brutal View does not entail that extended simples are possible, but it does not eliminate this possibility either.

Third, embracing the possibility of extended simples allows the advocate of *endurantism* to save the analogy between space and time. [Parsons (2000)]. The *endurantist* thinks that objects persist through time by being wholly present at each moment they occupy. However, the endurantist also holds that objects fill regions of space (at a time) by having parts that occupy (at a time) the subregions of those regions. If objects can be wholly present at different times, but it is not *possible* for them to be wholly present at different spaces (at the same time), then the analogy between space and time is greatly weakened. The way objects can occupy space is radically different from the way objects can occupy time.

One conception of extended simples – the *Parsonian Conception* – holds that extended simples are objects that are wholly present across different regions of space.[2] Here is a formal definition of a Parsonian Simple:

> x is a *Parsonian extended simple* =df. (i) there is an extended continuous region R such that for some *rs*, R is the fusion of the *rs* and x occupies each of the *rs*, and (ii) x has no proper parts.

On this conception of extended simples, the analogy between space and time holds. If extended simples are possible, then it is possible that objects be wholly present across space as well as time. Parsonian extended simples fill extended regions by occupying a series of subregions of those regions.

There is another reason that endurantists should be sympathetic towards extended simples: some enduring objects *are* spatiotemporally extended simples. Consider an enduring point-particle.[3] It cuts a path through spacetime. This path is extended. Since the particle occupies an extended region of spacetime, it is an extended simple. Admittedly, this region is composed of timelike separated points. But, once the endurantist grants that some simples are extended in spacetime, she will have a hard time arguing against the possibility of extended simples that occupy regions composed of spacelike separated points.

One reason is that granting the possibility of extended simples that occupy one kind of spacetime region, namely, those that are composed of spacetime points that are timelike separated, but denying that extended simples can occupy spacetime regions that are composed of spacelike separated points involves accepting an unmotivated restriction of a very attractive principle of recombination. I will now briefly explain why this is so.

Material occupants and regions are members of different ontological categories, but they can bear one important and special relation to each other: the occupation relation. This relation is an irreducible relation that links objects of distinct ontological categories. It is also, if endurantism is true, a one-many relation: one object can occupy many regions of spacetime.

It is a plausible hypothesis that spacetime points have the same intrinsic character.[4] In that case, any two regions of spacetime that have the same structural properties (such as size and shape) have the same intrinsic character. Consider now a world in which enduring objects persist through a homogenous Newtonian spacetime. Suppose a point-sized object *o* is wholly present at spacetime points *r1* through *r2*. The region these points compose is a continuous region of spacetime, which is extended in the "temporal" dimension but unextended in the three "spatial" dimensions.[5] Let us call this region *R*. Consider now a region *R'* that is intrinsically just like *R* but is instead extended in one of the spatial dimensions and unextended in the temporal dimension. Since (i) *o* can be wholly present at the various parts of *R*, (ii) *R* is intrinsically just like *R'*, and (iii) the occupation relation is a fundamental external relation, we should conclude that (iv) it is metaphysically possible for *o* to be wholly present at the various parts of *R'*.[6] But then Parsonian extended simples are possible.

A third reason to believe in the possibility of Parsonian extended simples stems from considerations involving time travel. Consider a time-traveling point-particle *o*. *o* persists by enduring from *t1* to *t2*. At *t2*, *o* enters a time-machine, which returns *o* to *t1* but in a different spatial location. *o* time-travels in this fashion "many times" so that, at *t1*, the union of the spatial regions occupied by *o* is continuous.[7] Let us call this continuous region R. At $t1$, o is a Parsonian extended simple. So, if the endurantist accepts the possibility of time-travel, then she should accept the possibility of Parsonian extended simples.

I do not think that the only kind of extended simples that are possible are Parsonian ones. I also wish to defend the possibility of extended simples that are spread out in space without enjoying multi-location.[8] Such extended simples would *dominate* the regions they occupy. David Lewis entertains (but does not endorse) the hypothesis that *singleton sets* might be this sort of extended simple. He writes:

> Perhaps, indeed, every singleton is just where its member is. Since members of singletons occupy extended spatiotemporal regions, and singletons are atoms, that would have to mean that something can occupy an extended spatiotemporal region otherwise than by having parts that occupy different parts of the region, and that would certainly be peculiar. But not more peculiar, I think, than being nowhere at all... [Lewis (1991): 32].

And later in the same book, Lewis writes:

> Finally, if something occupies a region, mereology *per se* does not demand that each part of the occupied region must be occupied by some part – proper or improper – of the occupying thing. If not, that's a second way for a singleton atom to be where its extended member is. [Lewis (1991): 76].

I will call simples of this type *toughies*, and offer the following definition of them:

> *x dominates R* just in case (i) *x* occupies *R*, (ii) it is not the case that *x* occupies some proper sub-region of *R*, and (iii) no proper part of *x* occupies a proper part of *R*.
>
> *x* is *toughie* =df. There is an extended continuous region *R* such that *x* dominates *R*.

I think the arguments I advance in this paper provide a defense of both kinds of extended simples.

3.2 Three Puzzles Involving Extended Simples

There are good reasons to believe that extended simples are possible. Nonetheless, there are three challenges that the advocate of extended simples must face.

3.2.1 First Puzzle

The history of philosophy has not been kind to extended simples. It is this argument, or something very similar to it, that leads many philosophers to reject the possibility of extended simples:

(1) If there were an extended simple, then it would have two halves.

(2) If it had two halves, then the simple would have proper parts.

:. Hence, there can't be any extended simples.[9]

Let us understand (2) so that it is analytically true. That is, let us understand talk about *halves* in such a way that a half of an object is literally a part of that object. If we understand (2) in this fashion, the main premise in the argument is (1). What can be said in its defense?

Let us note that (1) is *not* analytic. It is no contradiction to deny premise (1). Moreover, (1) is neither an axiom of standard mereology, nor does it follow from any set of axioms of standard mereology. A defense of (1) must appeal to principles that go beyond the province of pure mereology.

One way of arguing for (1) is via an appeal to a more general principle that entails (1). The principle that I have in mind is the *Doctrine of Arbitrary Undetached Parts* (DAUP):

> (DAUP): Necessarily, for every material object M, if R is the region of space occupied by M, and if sub-R is *any* occupiable sub-region of R *whatever*, there exists a material object that occupies the region sub-R and *which is a part of M.*[10]

But simply appealing to DAUP will not settle the issue. For the defender of the possibility of extended simples will simply reject DAUP. And then we will have reached an argumentative stalemate. In order to prevent this from happening, it is important to first determine what can be said in defense of DAUP. The next step, in order to prevent argumentative gridlock, is to figure out if the advocate of extended simples can reasonably reject some part of the case for DAUP without begging the question. This is the first challenge facing the defended of extended simples.

3.3.3 Second Puzzle

The second puzzle facing the advocate of extended simples concerns the possibility of simple yet extended regions of space. In order to see that this a genuine worry for the advocate of extended simples, we need to first see what the possibility of extended simples implies about the nature of space.

I believe that an advocate of extended simples ought to embrace a view about space called *substantivalism*. Substantivalism is the conjunction of the following theses:

(1) There exist spatial points and spatial regions.[11]

(2) Points are particulars, not properties.[12] Points are simples, not mereologically complex wholes.

(3) Points or regions are not reducible to constructions made out of their actual or possible occupants. So, for example, points or regions are not propositions, sets, ordered tuples, or possibilities of location. (Forbes 1987).

(4) Regions are mereological fusions of points.

(5) The structural features of a region, such as its shape, are intrinsic features of the region.[13]

I assume that the advocate of extended simples will want to talk about the points, lines, or surfaces lying on or within extended simples. Moreover, the advocate of extended simples will want to provide an account of continuity, spatial connectedness, and other geometrical or topological features that extended simples can have. If the advocate of extended simples has a sufficient number of point-sized objects in her ontology, she can provide the standard accounts of these concepts. For example, the advocate of extended simples can say that an extended simple is continuous if and only if it occupies a continuous region of space, where the concept of a continuous region of space is cashed out in the standard way.[14] This provides an excellent reason for the advocate of extended simples to embrace substantivalism.[15]

Given substantivalism, what is the status of the material contents of spatial regions? There are two possible answers. Either material objects are identical to the regions that they occupy or material objects are distinct from the regions of space they occupy. Let us call the latter view the *container* view. Worlds at which there exist extended simples must be worlds at which the container view is true. To see this, let us assume that there exists an extended simple, which I dub "Big Ed." The region occupied by Big Ed has proper parts, since it is an extended region and extended regions are fusions of points. But Big Ed does not have proper parts, so Big Ed cannot be identical to the region at which Big Ed exists. An interesting conclusion! If extended simples are possible, then we cannot identify these simples with the regions of space that they occupy.[16]

So the advocate of extended simples has a reason to believe in regions of space and a reason to believe that regions of space and occupants of regions form distinct ontological categories. But then the question facing the advocate of extended simples is pressing: why not also endorse the possibility of extended yet simple regions of space? This challenge is especially worrying, since the advocate of extended simples could undercut the argument just given by accepting that extended yet simple regions of space are possible.

It seems that extended yet simple regions of space are absurd. But it also seems that extended yet simple material objects are strange. Once we let one kind of crazy entity – extended yet simple material objects – in our ontology, doesn't consistency require us to let in the other kind – extended yet simple regions of space – as well? This is the second challenge facing advocates of extended simples.

3.2.3 Third Puzzle

Material occupants and regions are members of different ontological categories, but they can bear one important and special relation to each other: the occupation relation. The occupation relation has two interesting features: it is perfectly natural and it is external. Natural properties and relations are ontologically basic in this sense: the pattern of instantiation of the perfectly natural properties and relations determines the pattern of instantiation of every other qualitative property and relation. The notion of naturalness can be used to define other interesting concepts: objects are *intrinsic duplicates* if and only if there is a one-to-one correspondence between their parts that preserves perfectly natural properties and relations; a property is *intrinsic* if and only if it never differs between duplicates.[17] (A property is *extrinsic* just in case it is not intrinsic.) *External relations* do not supervene on the intrinsic properties of the things they relate; however, they do supervene on the intrinsic properties of the whole composed of the things they relate.

The occupation relation does not supervene on the intrinsic properties of its relata. Consider an occupant *O* and the region *R* that *O* occupies. Both *O* and *R* have the same shape; but so do many other regions besides *R*. If space is infinitely extended and topologically and metrically homogenous, then there will be infinitely many regions that are duplicates of *R* and hence have the same intrinsic properties as *R*. But *O* does not occupy those regions as well as *R*.

However, although the occupation relation does not supervene on the intrinsic properties of its relata, it is *constrained* by some of the properties of its relata, specifically the shape properties of its relata. For it is impossible for an extended simple to occupy a single point of space, i.e., to be completely there and nowhere else. That is, necessarily, if something is an extended simple, then it does not occupy a single point. Given that the occupation relation is a fundamental external relation, how could it be constrained by the intrinsic properties of its relata in this fashion?

The principle that any material simple can occupy any simple region of space is extremely compelling. If extended simples are not possible, then this principle is free from counter-example. However, it appears that, if extended simples are possible, then this principle must be restricted. So, if extended simples are possible, then an intuitively plausible recombination principle seems to be false. This is the third puzzle facing the advocate of extended simples.

3.3 A Solution to the Puzzles: the Extrinsic Theory of Shape

Although these challenges are distinct, I believe that a single solution suffices to defeat each of them. Briefly, the solution involves distinguishing two kinds of shape properties: *intrinsic* and *extrinsic* shapes. The solution requires saying the shapes of extended simples are extrinsic.

Allow to me to clarify what I mean by 'shape'. I use 'shape' to refer to the sum of those features of an object that are determined by its topological, geometrical, and metrical features. Accordingly, the *size* of an object is a part of its shape. Given this admittedly somewhat non-standard definition of 'shape', two cubical regions of Euclidean space that differ only with respect to their volumes have different shapes. However, given this definition of 'shape', *incongruent counterparts*, such as perfectly symmetrical left and right hands, have the same shape. Whether an object is a left or right hand is not determined solely by the topological, geometrical, or metrical properties of that object, but is rather determined by those properties *and* the relations it bears to other things.[18]

The *intrinsic shape* of an object is the shape that an object has in itself, independently of any relations it bears to other things. Its shape is an intrinsic property of the object. If a material object has an intrinsic shape, then its shape is metaphysically independent of the relation that it bears to a region of space that it occupies. Let us call the theory that all shape properties of material objects are intrinsic properties the *Intrinsic Theory* (IT).

The Intrinsic Theory seems obvious to many.[19] But it is not clear to me why this is so. What is obvious is that material objects have shape properties. But why believe that the shape properties of material objects are intrinsic properties? Perhaps instead material objects inherit their shapes from the regions of space that they occupy. Let us call the hypothesis that the shape of a region of space is an intrinsic property of that region, whereas the shape of a material occupant of that region is an extrinsic property, the *Extrinsic Theory* (ET). According to the Extrinsic Theory, a material object has its shape in virtue of the fact that it bears the occupation relation to a region with that shape.[20] The shape of a material object, on this view, is not metaphysically independent of the relations the object bears to other entities. Rather, the fact that material object has a shape is *constituted* by the fact that it bears a relation to a region of space that has that shape.[21] In a world without substantival space, no material object has a shape.

For the sake of completeness, I mention a third option, the *superimposition* theory, according to which the shape properties of an occupant are intrinsic, whereas the shape properties of a region are extrinsic. I do not discuss the superimposition theory in what follows. There is an even more outlandish option: shape is extrinsic to occupants *and* regions.[22] But then whence comes shape? I will ignore this theory as well.

The Extrinsic Theory may seem strange since it implies that the shape of a material object is actually an extrinsic, derivative feature of that object. However, there are precedents for this position. Ignore worries about extended simples for a moment and consider the various distance relations that obtain between point-sized material objects. Graham Nerlich has recently argued that the spatial relations that obtain between material objects obtain in virtue of the spatial relations that obtain between the regions they occupy. [Nerlich (1994): 19-43]. If this is the case, then the distance relations obtaining between these material objects are *extrinsic*, i.e., they depend on the properties of objects other than the relata of the relation.[23] This in turn entails that the shape of the fusion of the point-sized occupants is an extrinsic property of that fusion.[24] This does not yet give us the extrinsic theory, since it is consistent with Nerlich's position that the property of being point-sized is an intrinsic property of material objects. But it certainly takes us a large step closer to ET, since, on this view, the shape of any composite material object is an extrinsic property.

Similarly, Theodore Sider has claimed that in order for the endurantist to accommodate special relativity, "the endurantist should say that spatiotemporal relations hold primarily between points of spacetime. Fundamental particles then stand in spatiotemporal relations derivatively by occupying points of spacetime that stand in those relations." [Sider (2001): 81]. This is a version of the Extrinsic Theory.[25]

Finally, if we adopt the Parsonian Conception of extended simples, we might be required to endorse ET. Recall that, according to the Parsonian Conception, extended simples are objects that are wholly present at multiple spatial regions. In short, extended simples enjoy multi-location. But any advocate of multiply located objects should embrace something like the extrinsic theory. For the friends of multi-located objects face *the Paradox of Multi-Location*, which is best solved by appealing to something like the Extrinsic Theory.

In a recent paper, Stephen Barker and Phil Dowe argue that multi-location is impossible.[26] An object enjoys multi-location just in case it is wholly present at more than one (distinct) space-time region. One popular view that is committed to multi-located objects is *endurantism*, which is the doctrine that objects persist through time by being wholly present at each time they are located.[27] So, if Barker and Dowe are right, endurantism is in big trouble.

Here is a brief summary of Barker and Dowe's argument. Endurantists say that enduring objects are not *extended* in time, which suggests that they are three-dimensional entities.[28] Consider an enduring object O that is wholly present at each three-dimensional spacelike hyperplane of spacetime region R. So, for each such r, O occupies r. So O completely fills a four-dimensional region of spacetime. Moreover, for any $r \subseteq R$, O has a part at r. But then O is actually a four-dimensional entity. But nothing can be both three-dimensional and four-dimensional. So endurantism is false.

Recall that the shape of an object is the sum of that object's topological, geometrical, and metrical properties. An object's dimensionality is one part of an object's shape. Barker and Dowe's argument can be thought of as instance of a more general problem, the problem of determining what the shape of a multi-located object is. For example, Barker and Dowe consider an enduring time-traveler who comes in physical contact with himself.[29] How *big* is this person at the moment at which he enjoys spatial bi-location? What is the shape of this person at that moment?

The endurantist should respond to Barker and Dowe's paradox by distinguishing between two kinds of shape properties. First, an object can have an intrinsic shape. An object has a shape intrinsically if it has that shape in virtue of the way that object is in itself. Second, an object can have an extrinsic shape. An object has a shape extrinsically if it has that shape in virtue of the way that it relates to regions of spacetime. Arguably, standard endurantism is committed to spacetime substantivalism, and to claiming that enduring objects are not identical to the regions of spacetime that they occupy.[30] So standard endurantism is committed to at least two ontological categories: spatiotemporal regions and enduring objects that occupy those regions. Objects and regions are brought together by the occupation relation. An object can have a shape *extrinsically* in virtue of occupying a region of spacetime that has that shape *intrinsically*. The extrinsic shape of an object is the intrinsic shape of the region of spacetime that it fills.

Suppose that *O* is an enduring solid ball. What shape is *O intrinsically*? *O*'s intrinsic shape is spherical. What shape is *O extrinsically*? Since *O* occupies a successive series of spherical regions of spacetime, the region of spacetime that *O* fills is not spherical. Instead, the shape of the region of spacetime filled by *O* is the four-dimensional analogue of a cylinder. This is *O*'s extrinsic shape. So *O*'s extrinsic shape is not spherical. But no contradiction is entailed by the fact that *O*'s intrinsic shape differs from *O*'s extrinsic shape. Nothing can have two different *intrinsic* shapes, but *O* does not have two different intrinsic shapes.

Consider two persisting solid balls *O1* and *O2* such that, at each time that they exist, *O1* and *O2* are qualitatively indiscernible. Let us assume that each object has the same properties at any time that it is present, i.e. neither object undergoes qualitative change. Suppose that *O1* persists from *t1* to *t3*, whereas *O2* persists from *t1* to *t4*. *O2* enjoys a longer lifespan than *O1*, but given how I have set up the case, no endurantist should think that *O2* differs intrinsically from *O1*. *O1* and *O2* are qualitative duplicates; *O2*'s lasting longer than *O1*is an extrinsic difference, not an intrinsic one. There is a sense in which *O1* and *O2* have a different shape; this is because they differ with respect to their extrinsic shapes. But we can still say, if we wish, that they have the same intrinsic shape; both *O1* and *O2* are intrinsically three-dimensional spheres.

Since claiming that the shapes of extended simples are extrinsic properties is not unprecedented or unreasonable, this is an acceptable move for the advocate of extended simples to make if it helps solve the puzzles confronting the advocate of extended simples.

3.4 How the Extrinsic Theory Solves the First Puzzle

Recall that, in order to avoid an argumentative deadlock, we need some reason to believe DAUP. I think an interesting argument for DAUP can be made. The argument for DAUP has two premises. The first premise is a general principle that I call the *Principle of Qualitative Variation* (PQV):

> (PQV): For any object *x*, regions R+, R1, and R2, and intrinsic properties F1 and F2, if (i) *x* occupies R+, (ii) R1 and R2 are non-overlapping proper subregions of R+, (iii) F1 is not identical to F2, (iv) *x* instantiates F1 *at* R1, and (v) *x* instantiates F2 *at* R2, then there are two objects *x1* and *x2* such that (a) *x1* is not identical to *x2*, (b) *x1* and *x2* are non-overlapping proper parts of *x*, and (c) *x1* instantiates F1 and *x2* instantiates F2.[31]

Informally, PQV states that, whenever an object has intrinsic properties distributed within the region it occupies, it has parts corresponding to the locations where its qualities are distributed. Here is an example of PQV in action. Assume that colors are genuine properties of objects. Now consider a sphere such that the top half of the sphere is blue and the bottom half of the sphere is yellow. Given PQV, the sphere must have proper parts corresponding to the region at which it is blue and the region at which it is yellow.

The adverbial phrase "at R" modifies the copula, not the predicate. The phrase "x has F at R" does not indicate that x bears a relation, specifically, the F-at relation, to a region *R*. Instead, the phrase indicates that *x* has-relative-to-*R* the property Fness. One could reject PQV and instead accept *spatial adverbalism*, according to which the instantiation relation that links objects to their properties is really a three-place relation between an object, a property, and a region of space. The strategy is analogous to adopting *temporal adverbalism* in order to avoid the problem of intrinsic change over time. (On this issue, see Johnston (1987) and McDaniel (2003a).)

PQV implies that, in cases in which *F* is a genuine property, propositions of the form *x* is *F* at location *R* have the same truth-values as propositions of the form *y* is *F*.[32] In cases in which *F* really is a property, and not a disguised relation that an object bears to a region, this implication is plausible. Given PQV, indexing properties to regions has no deep metaphysical significance. The instantiation relation that links objects to their properties is a two-place relation.

It is important to distinguish the following two situations: (1) the situation in which *x* has-relative-to-region-*R* the property Fness and (2) the situation in which *x* has Gness, where Gness is an extrinsic property that *x* has in virtue of bearing a relation to a region of space. In the first situation, *x* has a property relative to a region. In the second situation, *x* just plain instantiates Gness; *x* does not instantiate Gness relative to any region of space. Here is a concrete example of the second sort of situation: suppose *x* is five feet from a region of space *R*. Then *x* has the *extrinsic property* being five feet from *R*. But *x* does not have this property relative to any region of space; *x* just plain has the property. In this case, PQV does not imply that *x* has a property at *R*.

A case can be made for PQV simply by attending to the consequences of denying it. Suppose PQV is false. Consider a sphere-shaped extended simple that is blue at one proper sub-region of the region it occupies (call this region 'Bluefilled') and yellow at a distinct sub-region (call this region 'Yellowfilled'). If this sphere is an extended simple, then strictly speaking it does not have a top-half that is blue, even though the sphere is blue *at* Bluefilled. But what just plain instantiates the property of being blue? Nothing does![33]

If we abandon PQV, then it is very hard to see why we should believe that any object has parts. And even the advocate of extended simples believes that some objects have proper parts. In his recent book, *Four-Dimensionalism*, Theodore Sider discusses three reasons to posit proper spatial parts. [Sider (2001): 87-92]. First, some objects are extended. Obviously, the advocate of extended simples cannot agree that extension implies the possession of proper parthood. So this reason to posit proper parts is unavailable to the advocate of extended simples.

Second, some objects are qualitatively heterogeneous, that is, they have properties at various sub-regions of the regions that they occupy. If we accept that we should posit parts whenever an object is qualitatively heterogeneous, then we accept PQV. Accordingly, I do grant that the defender of extended simples should not claim that *heterogeneous* extended simples are possible. So, as I see things, only qualitatively *homogenous* extended simples are possible.

Sider also discusses a third reason to posit spatial parts:

> Call the left half of the region of space occupied by the desk 'R'. R and its material contents might have been, intrinsically, exactly as they actually are even if the rest of the world had been eliminated. In that case an object occupying R would have existed. But then we should postulate an object in actuality that occupies R. For surely the elimination of the rest of the world outside of R would not bring a *new* object into existence; but what other actual object could this object be, other than a part of the desk that actually occupies the region R? [Sider (2001): 89-90].

Suppose we have before us a putative extended simple *O* and the region *R* that it occupies. Let us assume that the object is qualitatively homogenous. Let us call the left-hand region of space that is a proper part of region occupied by *O*, *Lefty*. Lefty could have been the only region of space that exists. Moreover, according to Sider, all of the intrinsic properties that are instantiated by *O* at Lefty could have been instantiated by *something* at Lefty even if Lefty and what it contains were the only things in existence. In this case, Sider suggests that we should posit a part of *O* that exists exactly at Lefty.

Sider's argument for the existence of spatial parts seems to presuppose that the shape properties of material objects are intrinsic, which the advocate of extended simples can deny. (This is because this presupposition is needed to rule out *O* being the one material object at the counterfactual world we are considering.) Suppose that she does deny this. In this case, the advocate of extended simples should say that (1) in the counterfactual world *w* that Sider considers, *O* exists, (2) *O* occupies Lefty at *w*, (3) the set of intrinsic properties instantiated at Lefty in world *w* is identical to the set of intrinsic properties instantiated at Lefty in the actual world, and (4) the set of intrinsic properties instantiated by our extended simple in world *w* is identical to the set of intrinsic properties instantiated by our extended simple in the actual world.

Sider's modal argument is very similar to the argument from PQV to DAUP. Assume that an object has an intrinsic property at a sub-region of the region it occupies. Given PQV, it has a part at that subregion. So wherever an object enjoys intrinsic variation, it has proper parts. Sider tells us to focus on this subregion and then consider a world in which it and its contents are the only things there are. Since nothing new has been created by subtracting the rest of reality, there actually is a proper part of the object that occupies this subregion. So wherever an object enjoys intrinsic variation, it has proper parts. Given the similarities between the two arguments, I will focus on the argument from PQV to DAUP.

PQV does not by itself imply DAUP. We can see this if we consider that the conjunction of PQV and the Extrinsic Theory is consistent with the denial of DAUP. (More on this in a moment.) However, the conjunction of PQV and the claim that the shape properties of material objects are intrinsic *entails* DAUP. Suppose that a material object *o* occupies a cubical volume of space *R*. Then the property of being a column will be instantiated by *o* at the bottom half of *R* (call this region *Bottom*) and at the top half of *R* (call this region *Top*). If shape properties are intrinsic properties, then being a column is an intrinsic property. And so, given PQV, there is a part of *o* that occupies Bottom and a part of *o* that occupies Top.

Suppose space contains point-sized parts. On this supposition, being point-sized will be instantiated by *o* at every point of space in *R*. And so, given PQV, *o* will have infinitely many point-sized parts. If shapes are intrinsic properties, there is as much pressure to claim that *o* has parts at every sub-region of *R* as there is to claim that the sphere has a part where it is blue. If the shape of a material object is intrinsic and PQV is true, then DAUP is true.

Another example may be helpful. Suppose you are in a room with an open door. Suppose that workers are moving a large statue through the door. From what you can see, you are inclined to say to that you see something shaped like a human arm. (Because of the angle from which you are viewing the statue and the wall between you and the hallway, you can't see the statue in its entirety.) Let us call the region of space that the statue currently occupies *R*. *R* overlaps the region occupied by the room you are in; *R* also overlaps the region occupied by the hallway. *R* is shaped like a statue. *R* is a region of space, and it does have an arm-shaped sub-region *R*-. Let us call the shape of this subregion *being arm-shaped*. The statue is arm-shaped at *R*-. If the Intrinsic Theory is true, then being arm-shaped is a property that material objects have intrinsically. But, then, given PQV and the Intrinsic Theory, the statue has an arm-shaped part that occupies the arm-shaped region.

It makes sense to talk about the properties that an object has at a particular place. But, given PQV, this sort of claim must be analyzable in terms of talk of "just plain instantiation," parthood, and occupation.[34]

If the Extrinsic Theory is true, then the shapes of material objects are really derivative features. Talk about shapes had by an object at a region is analyzable in terms of shapes had by the region itself and the occupation relation. We can say that an object *o* is *S*-shaped at *R* just in case either (i) *o* or a part of *o* occupies *R* and *R* is *S*-shaped or (ii) *o* or a part of *o* occupies some region *R*+ such that *R* is a subregion of *R*+ and *R* is *S*-shaped. Given ET, when we say that an object is *S*-shaped at a region, we do not ascribe a particular quality to that object. Instead, we say something about the region that the object occupies. This is why the conjunction of PQV and ET does not imply DAUP, even though the conjunction of PQV and the Intrinsic Theory does.

No one should be tempted by the following principle: if *o* bears a relation *F* to *r1* and a different relation *G* to *r2*, then *o* has a proper part located at *r1* and a proper part located at *r2*. If this principle were true, then extended simples would be impossible. Given the Extrinsic Theory, having a shape at a region consists in bearing a relation to a region with that shape. So extended simples would have parts corresponding to the regions of space that they occupy. But this principle is far too strong. For it also implies that a point-sized simple that is four feet away from region *r1* and five feet away from *r2* has parts at *r1* and *r2*. The moral we should draw is this: the mere fact that an object bears different relations to different regions of space is not a reason for holding that the object has proper parts at those regions of space. And, if the Extrinsic Theory is true, having a shape at a region simply consists in bearing a relation to a region.

ET provides the resources to undermine the argument for DAUP. If the shape of an extended simple is not intrinsic, then the pressure to split up an extended simple *simply because it is extended* is entirely eliminated. We are justified in positing parts in accordance with PQV, but if the shape properties of material objects are not intrinsic, PQV simply does not apply. Since the advocate of extended simples can justifiably endorse ET, the argumentative stalemate is broken. The advocate of extended simples can reject DAUP without begging the question. The first challenge has been met.

3.5 How the Extrinsic Theory Solves the Second Puzzle

There are two sorts of worries one might have about the notion of an extended yet simple thing. First, there is the worry that the notion of an extended yet simple thing is incoherent. One might have this worry if one thought that the notion of the shape of an entity must be analyzed in terms of the distance relations obtaining between this entity's proper parts. The Extrinsic Theory shows that this worry is somewhat misguided: we can make sense of a material object having a shape without appealing to the distance relations obtaining between *its* proper parts provided that there is some other entity – a region of spacetime – that it occupies, has the same shape as, and is such that the region's shape can be analyzed in terms of the distance relations obtaining between *the region's* proper parts.

There may, however, be an analytic connection between having a shape *intrinsically* and having proper parts that bear distance relations to each other. If this is the case, then the friend of extended yet simple regions of spacetime has a conceptually impossible position. For the friend of extended yet simple regions of spacetime needs to assume that it makes sense to talk about the shape of a region of spacetime independently of our ability to analyze these notions in terms of parts of the region. She needs to be able to say, for example, that a particular region of space is box-shaped and has a cubic volume of 30 meters even if that region of space is an extended simple.

It is actually to the advantage of the advocate of extended material simples if this assumption is false. For, without this assumption, we have no way to account for how a region of spacetime could have extension even though it is simple. But we still have a way, via the Extrinsic Theory, of accounting for how an extended material object could be a simple. So we would lose the reason to hold that if extended material simples are possible, then extended yet simple regions of spacetime are possible. The alleged parallel between these two putative possibilities would not hold. So it may be that the concept of an extended yet simple region of spacetime is incoherent, even if the concept of an extended yet simple material object is not incoherent.

My second worry about extended yet simple regions of spacetime is similar to the worry about extended yet simple material objects discussed in section 3.4. Recall that the worry in section 3.4 was centered on the claim that if something is extended, then it has proper parts. In section 3.4, I argued that this inference is good only if the extended thing is *intrinsically* extended. However, according to the Extrinsic Theory, some or all of the shape properties of extended material simples are extrinsic. However, all of the shape properties of regions of spacetime are intrinsic. Shapes are genuine qualities of regions, qualities that these regions have independently of the relations they bear to other (non-overlapping) regions. It is this difference that grounds the fact that extended yet simple regions of spacetime are not possible even if extended yet simple material objects are possible.

The strategy to break the alleged parallel between extended yet simple regions and extended yet simple material objects is clear: show that, since the shape properties of regions of spacetime are intrinsic, a principle similar to DAUP, which has been formulated so as to apply to regions of spacetime instead of material objects, is true.

However, it is hard to see what the principle should look like. Recall DAUP:

> (DAUP): Necessarily, for every material object M, if R is the region of space occupied by M, and if sub-R is *any* occupiable sub-region of R, there exists a material object that occupies the region sub-R and *which is a part of M.*

We want a principle analogous to DAUP, but which applies to spacetime regions instead of material objects. DAUP appeals to the notion of an occupiable region, which does not have a clear analogue to the case of regions of spacetime.

In order to formulate an analogous principle, we will need to appeal to an abstract model of spacetime, < **U**, **D**>, where **U** is an infinite set of elements, which we can think of as representations of *points of spacetime*, and **D** is the distance function defined on **U**.[35] Any non-empty subset of **U** accordingly is a representation of a region whose shape is fixed by the distance relations obtaining between its elements.

Next, we need to be able to say that some representations of regions in our model represent the shape of real regions of spacetime. When this happens, let us say that the representation of a region and the real region of spacetime represented *have the same shape*.

How does this representation work? If there are no extended yet simple regions of spacetime, the representation works by structural isomorphism: the real distance relations between points of spacetime are mirrored by the relations determined by **D** that are defined on **U**. If there are extended yet simple regions of spacetime, we cannot say that the representation works this way. In fact, it is unclear if we can account for how it works. This problem is closely related to the first worry about the conceptual incoherence of extended yet simple regions of spacetime discussed at the beginning of this section. I suspect that the friend of extended yet simple regions will want to say that there is simply an additional fact about which subsets of **U** represent or correspond to real regions of spacetime.[36]

We now formulate our principle as follows:

DAUP-R: Let *R* be a region of spacetime. Let *S* be a non-empty subset of U such that *S* has the same shape as *R*. Then for any non-empty subset of *S*, *S*-, there is a region of spacetime *R*- such that *S*- and *R*- have the same shape and *R*- is a part of *R*.

Now that we have properly formulated the conclusion, we need to attend to the proper formulation of the premises. The first premise is an even more general version of PQV:

(PQV*): For any entities *x*, *y* and z and distinct intrinsic properties F1 and F2, if *x* instantiates F1 *at y* and *x* instantiates F2 *at z*, then there are two entities *x1* and *x2* such that (a) *x1* is not identical to *x2*, (b) *x1* and *x2* are non-overlapping proper parts of *x*, and (c) *x1* instantiates F1 and *x2* instantiates *x2*.

Intuitively, PQV* tells us that entities can have properties indexed to or *at* other entities only derivatively, in virtue of proper parts that have those properties in a non-indexed, non-derivative manner. There is no irreducible indexing on the having of properties. Instantiation is fundamentally non-relative. Presumably, the intuitions that supported PQV provide the same support for PQV*.

Our second premise is this:

(POS-OCC): For any region of spacetime *R*, there is a possible world *w* in which (i) *R* has the same intrinsic properties in *w* as it has at the actual world, (ii) *R* is occupied by a material object *M* such that *M* is composed of arbitrary undetached parts.[37]

In other words, any region of spacetime could be occupied by a material object that is made of arbitrary undetached parts. What motivates POS-OCC? The motivation is straightforward: in general, if an object has the same shape as a region of spacetime, then it is metaphysically possible for that object (or at least a duplicate of that object) to occupy that region of spacetime. Suppose that *R* is a region of spacetime. Then, necessarily, any material object that is shaped like *R* could occupy *R*. Moreover, this is true regardless of any qualitative intrinsic properties of the object or the region other than the shape of the object or region. How could the intrinsic properties of a material object (other than shape) necessarily prevent it from merely occupying a region of the same shape? And how could the intrinsic properties of the region necessarily repel objects of the same shape?

Since the other intrinsic properties of a material object and the intrinsic properties of a region are no barrier to the object occupying the region if they are the same shape, the mereological structure of the object or the region are not barriers to the object occupying the region. So, for example, a mereological complex material object could occupy a mereologically simple region provided that the two regions have the same shape.

Consider an empty region *R*. Suppose that at some world *w*, there is a material object *o* shaped like *R* that is composed of arbitrary undetached parts that occupies *R*. Suppose that *R* has the same intrinsic properties in *w* as it actually has. Given POS-OCC, each of these suppositions is legitimate.

Suppose that *o* has a proper part that is shaped like a cube. In a case like this, we intuitively want to say that, in *w*, *R* has a proper part that is shaped like a cube. Where does *R* have this part? This part is, intuitively, the region that the proper part of *o* occupies. But we can't say that this is the case without conceding that *R* is not a simple. What we can say, however, is that the *region R* is cube-shaped *at* the part of the material object that is shaped like a cube.

Likewise, the rest of *o* is *S*-minus-a-cube-bit shaped. And so *R* is *S*-minus-a-cube-bit shaped *at* the part that is the rest of *o*.

Our third premise is that regions have their shapes intrinsically. (Recall that this is one conjunct of the Extrinsic View.) Since regions have their shapes intrinsically, being cubical is a property that regions of space have intrinsically. And so is being *S*-minus-a-cube-bit shaped.

So now PQV* comes into play. Since being cubical and being *S*-minus-a-cube-bit shaped are both intrinsic properties that are had *at* entities, specifically proper parts of *o*, PQV* implies that *R* has proper parts at this possible world. At *w*, *R* is not an extended simple.

But *R* has the same intrinsic properties at *w* as *R* has at the actual world. Since being a simple is an intrinsic property, *R* is an extended simple at *w* if and only if *R* is an extended simple at the actual world. So, since *R* is not an extended simple at *w*, *R* is not an extended simple.

Since our examples were chosen arbitrarily, we are allowed to conclude that any region of spacetime that is possibly filled by an object composed of arbitrary undetached parts itself is composed of arbitrary undetached parts. And, since all regions of spacetime are possibly filled by objects composed of arbitrary undetached parts, all regions of spacetime are themselves composed of arbitrary undetached parts. In other words, DAUP-R is true.

Because regions of spacetime have their shapes intrinsically, DAUP-R is true. Since the advocate of extended simples can say that material objects have their shapes extrinsically, they can reject DAUP. So the symmetry is broken. The possibility of extended yet simple material objects does not imply the possibility of extended yet simple regions of space. In fact, the very theory that undercuts the first challenge facing the advocate of extended simples also undercuts the second challenge.

3.6 How the Extrinsic Theory Solves the Third Puzzle

The third challenge is generated by the worry that extended simples seem to violate an intuitive principle of recombination. Let *R* be a perfectly natural external relation; let *C1* and *C2* be ontological categories. The intuitively plausible principle is this: if some simples of category *C1* can bear *R* to some simples in category *C2*, then any simple from category *C1* can bear *R* to any simple in category *C2*, regardless of their intrinsic properties.[38]

If the Intrinsic Theory is true and extended simples are possible, then we do have a counter-example to the principle of recombination. It is a necessary truth that no extended simple occupies a point-sized region of space.[39] The intrinsic properties of a material extended simple prevent it from bearing a perfectly natural relation to a simple region of space that other material simples (with different intrinsic properties) could bear to that region.

The Extrinsic Theory dissolves this worry. Given the extrinsic theory, the fact that an object cannot occupy a region with a different shape is no more mysterious than the fact that siblings must have the same parents. The reason you cannot put a spherical object in a cubical region is that objects are spherical in virtue of occupying spherical regions. And so on for other shapes.

Consider an extended simple *o*. Given ET, *o* is extended *in virtue of occupying a region that is extended.* Being extended is not an intrinsic property of *o*. So *o* could have occupied a point-sized region of space without this necessitating a change in *o*'s intrinsic properties. *o*'s intrinsic properties do not prevent it from occupying a point-sized region. Given ET, there are possible worlds *w1* and *w2* according to which (1) at *w1*, *o* is extended, (2) at *w2*, *o* is point-sized, but (3) for any intrinsic property *F*, *o* has *F* at *w1* if and only if *o* has *F* at *w2*. Given ET, extended simples do not generate counter-examples to the plausible principle of recombination. The third challenge has been met.

3.7 Why There Are No Actual Temporally Extended Simples

So far I have concentrated on the relationship that occupants bear to space. I have neglected the relationship that occupants bear to time (or to space-time.) It seems to me that the conclusions of the previous sections have some relevance to the current debate between so-called endurantists and perdurantists about how objects persist through time. But, in order to see whether this is the case, we first must readdress two fundamental questions.

The first question we need to readdress is: what is (or are) the fundamental mereological relation (or relations) that obtains (or obtain) between objects. As I noted in Chapter One, many endurantists take the fundamental parthood relation to be a three-place relation between two objects and a time: *x* is a part of *y* at *t*. On the other hand, every perdurantist takes the fundamental parthood relation to be a two-place relation between two objects: *x* is a part of *y simpliciter*. A related issue concerns what the fundamental instantiation relation is. Many endurantists take the fundamental property instantiation relation to be a three-place relation between an object, a property, and at time: *x instantiates F at t*, while every perdurantist takes the fundamental instantiation relation to be a two-place relation: *x instantiates F* simpliciter.[40] This is the kind of adverbalism rejected in the Introduction. On both of these issues, I side with the perdurantist.

Consider now the following account of Four Dimensionalism presented by Ted Sider in his paper "Four Dimensionalism." [Sider (1997)].

> **Four Dimensionalism** is the thesis that for any x, and any non-empty non-overlapping sets of times T1 and T2 whose union is the time span of x, there are two objects $x1$ and $x2$ such that the time span of $x1$ is T1, the time span of $x2$ is T2, and x is the fusion of $x1$ and $x2$.

Although I believe that four-dimensionalism is actually true, I deny that four-dimensionalism is necessarily true, for two reasons. First, I accept the possibility of Parsonian extended simples that are extended in the temporal region. We could call these objects *endurers*. Second, I accept the possibility of spanning extended simples that are extended in the temporal region. Let us call these objects *toughies*. It seems to me that both endurers and toughies are possible and four-dimensionalism as formulated by Sider in Sider (1997) implies that they aren't. Toughies are four-dimensional extended simples; they are objects that are extended in both time and space but lack both spatial and temporal parts at the sub-regions and sub-durations at which they exist. They dominate temporally extended spatiotemporal regions.

Given that toughies and endurers are possible, why not believe that they're actual? There are three kinds of entity that are candidates for being temporally extended simples: material objects, singleton sets, and immanent universals.

There are could reasons to deny that most or all material objects are endurers or toughies. Recall a principle that I employed earlier in this chapter: we ascribe parts to an object whenever there is an intrinsic variation within that object. Material objects can undergo intrinsic change, and this counts as a kind of intrinsic variation. It's this fact that leads to the so-called *problem of temporary intrinsics.*[41] Suppose that Jim is fat Monday and thin on Tuesday morning. Since Monday is just as real as Tuesday, "Jim is fat at Monday" is not analyzable into the timeless "Jim is fat." However, being fat is an intrinsic feature, not a disguised relation between a thing and a time. Consequently, 'Jim is fat at *t*' must be analyzable into a statement in which the temporal index, 'at Monday', does not appear, i.e., into a statement of the form, [*x* is Fat].[42] Accordingly, we have excellent reason to think that Jim does have a part – a temporal part – that is fat *simpliciter*.

An interesting upshot of this discussion is that the perdurantist can happily admit that her view is only contingently true without giving up arguments for four-dimensionalism that are primarily conceptual arguments. The perdurantist could argue that worlds at which objects enjoy multi-location at different times are worlds in which nothing undergoes intrinsic change. Since some objects do undergo intrinsic change in this world, endurantism must be (contingently) false. But since endurantism is contingently false, four-dimensionalism is contingently true.

However, this sort of consideration does not eliminate the epistemic possibility that singleton sets are endurers or toughies, or that immanent universals occupying spacetime via enduring or spanning. So for all that has been said here, there could be enduring or spanning sets or universals.

3.8 Concluding Remarks

As I see things, there are two morals to draw. I have argued that the three main reasons to reject the possibility of extended simples fail provided that the advocate of extended simples adopts the Extrinsic Theory of Shape. Since the Extrinsic Theory is neither unmotivated nor unprecedented, this is a respectable move for the advocate of extended simples to make. So the advocate of extended simples should endorse the Extrinsic Theory.

The second moral to draw is this: since the Extrinsic Theory is a live option, the case against extended simples has not been made. And, since there is some as of yet undefeated evidence for their metaphysical possibility, we should take the epistemic possibility of extended simples very seriously.

Notes

[1] x is a *disconnected region* just in case x is the sum of two regions $r1$ and $r2$ such that $r1$ and $r2$ are parts of non-overlapping open regions $R1$ and $R2$. x is *connected* just in case x is not disconnected.

[2] This is Parsons's conception of extended simples, which he calls *entended* objects. Dean Zimmerman seems to hold this conception of extended simples as well. See Zimmerman (2002): 402. See also Hawley (2001): 28, 49 and Lewis (1991): 76.

[3] I assume that point-sized objects are possible.

[4] On the assumption of endurantism, the claim that all spacetime points have the same intrinsic character is plausible. For given endurantism, material occupants cannot be identified with the regions they occupy. Since material occupants are distinct from the regions at which they are located, we can always assign physical properties, such as being the generator of an electromagnetic field, to material objects. However, the claim that all spacetime points are intrinsically alike is much less plausible given typical perdurantism. For the typical perdurantist can (and perhaps should) identify material objects with the regions that they occupy. Given this ontology, some spacetime points will differ from others intrinsically, since spacetime points are now the bearers of physical properties.

[5] Accordingly, this object would be a one-dimensional extended simple.

[6] See Sider (forthcoming) for a similar argument for the possibility of extended simples.

[7] When discussing time-travel, it is important to distinguish "personal time" from "objective time". Roughly, objective time is the time in which objects are ordered, whereas personal time is something that plays the same role in the history of the time-traveler as objective time does in the history of a non-time traveler. Let us assume that o only occupies $t1$ and $t2$. On this assumption, o enjoys only two moments of objective time. However, since o is a time-traveler that returns to visit itself often, o enjoys more than two moments of personal time. In fact, o enjoys infinitely many units of personal time, since at $t1$, o occupies a continuous region of space. From the perspective of o, o has visited $t1$ many, many (personal) times. See Lewis (1976) for a discussion of these issues.

[8] On this kind of simple, see Gilmore (forthcoming).

[9] Descartes discusses this argument in Descartes (1985), chapter II, section 20, p. 231. Markosian discusses it in Markosian (1998): 223-224.

[10] DAUP is discussed in van Inwagen (1983). (My statement of DAUP is slightly different from his.) I assume here that all regions of space – including point-sized regions – are possibly occupied by a material object.

[11] Every point is a zero-dimensional spatial region.

[12] This view is defended in Broad (1946).

[13] See Nerlich (1994) for a powerful defense of this claim.

[14] What is the difference between an unoccupied region of space and one that is occupied by an extended simple? More generally, how can we tell whether there is one there? Presumably, an extended simple would not be causally inert. So, if an extended simple is in a region, then, given the existence of appropriate laws of repulsion and attraction, other material objects could not enter the subregions of the region exactly occupied by an extended simple.

[15] There are other reasons to believe in the existence of regions of space (or at least regions of spacetime) that are independent of anything that I say in what follows. See Nerlich (1994) for an impressive and sustained argument for spacetime realism.

[16] Theodore Sider makes a similar point in Sider (2001): 110-119.

[17] These definitions come from David Lewis. See Lewis (1986): 59-69.

[18] Accordingly, I count myself as an advocate of *extrinsicism* about handedness, to use the terminology of James van Cleve. See van Cleve (1987) for an interesting discussion of philosophical problems concerning incongruent counterparts.

[19] For example, David Lewis writes, "If we know what shape is, we know it is a property, not a relation." [Lewis (1986): 204]. The context of this sentence makes it clear that Lewis holds that we know that shapes are intrinsic properties.

[20] Note that the Extrinsic Theory is compatible with the following claims: (1) necessarily, every object occupies some region of space or other (2) and hence, necessarily every object has some shape or other.

[21] This means that we shouldn't think that the way in which a region bestows shape on an object is similar to the way a container bestows shape on the liquid poured into it. In a case like this, the shape of the liquid is *causally* dependent on the shape of the container. But the liquid's shape is not *metaphysically* dependent on the shape of the container. The liquid has this shape *intrinsically* if and only if the container does. I thank David Robb for this helpful example.

[22] I know of no philosopher who holds the superimposition theory. However, Adolf Grunbaum appears to hold the more radical fourth possibility, which seems to be a consequence of his view that all metrical features are conventional, and accordingly, non-intrinsic features of the regions. [Grunbaum (1973), chapter 16].

[23] A relation is an *internal* relation iff it supervenes on the intrinsic properties of its relata; a relation is an *external relation* iff it does not supervene on the intrinsic properties of its relata but does supervene on the intrinsic properties of the fusion of its relata. A relation is an *intrinsic* relation iff it is either an internal or an external relation; otherwise, that relation is an *extrinsic* relation. On these definitions, see Lewis (1986): 61-63.

[24] On a related issue, see also Bricker (1993): 282-283.

[25] On this view, some material objects have intrinsic shapes. Specifically, the fundamental particles still have their shape intrinsically. However, since the spatiotemporal relations they stand in are extrinsic, any fusion of these particles has its shape extrinsically.

[26] See Barker (2003) and McDaniel (2003b).

[27] Endurantism is not Barker and Dowe's sole target; they also intend to refute the view that universals enjoy multi-location. For the most part, I will restrict my attention to the consequences of Barker and Dowe's argument for endurantism. On the multi-location of universals, see Armstrong (1997).

[28] Peter van Inwagen discusses a rough characterization of endurantism, according to which it is the view that "persisting objects are extended in three spatial dimensions and have no other kind of extent.". Perdurantism is characterized as the view that "persisting objects are extended not only in three spatial dimensions, but also in a fourth, temporal, dimension, and persist simply by being temporally extended". See van Inwagen (1990b).

[29] See Barker (2003): 109-110.

[30] See Sider (2001): 110-120.

[31] I thank an anonymous referee for this nice formulation of PQV. By "properties" I mean only one-place properties, whether intrinsic or extrinsic. (In some circumstances, it is convenient to think of relations as 2+-place properties. This is not one of those circumstances.)

[32] It may be that the objects substituted for *x* and *y* are identical; or it may be that they are not.

[33] There are two other moves available to the advocate of extended simples, neither of which involves rejecting PQV. First, one could accept that distributional properties, such as *being red at R1 while being blue at R2*, are ontologically fundamental and intrinsic. On this strategy, see Parsons (2000). Second, one could claim that, while no *thing* instantiates the property of being blue, nevertheless some *stuff* or *matter* instantiates the property of being blue. In general, the denier of PQV could claim that a property can be exemplified by some stuff without being exemplified by any particular thing; see Markosian (1998), 223-224 and McDaniel (2003a), 269-274 for a discussion of this strategy. There are problems with both moves.

[34] See Hinchliff (1996): 121-122.

[35] A distance function assigns non-negative real numbers to pairs of points and obeys the following constraints:

(i) D assigns exactly one number to each pair.
(ii) D assigns *n* to <*p*, *q*> if and only if D assigns *n* to <*q*, *p*>.
(iii) D assigns 0 to <*p*, *q*> if and only if *p* is identical to *q*.
(iv) If D assigns *n* to <*p*, *q*>, *m* to <*q*, *r*>, and *l* to <*p*,*r*>, then $n + m \geq l$.

[36] Similarly, the friend of gunky spacetime will want to say that not every subset of **U** represents or corresponds to a real region of spacetime. Instead, the friend of gunky spacetime might want to say that only non-empty (infinitely membered) continuous sets or unions of non-empty (infinitely membered) continuous sets represent or correspond with real regions. (And, of course, in this case the friend of gunky spacetime will need to spell out how representation works if not by structural isomorphism.)

DAUP-R entails the existence of point-sized regions of space, and hence eliminates the possibility of gunky space. This might seem problematic. If need be, we could replace DAUP-R with a weaker principle. Let us say that a subset S of **U** is *eligible* just in case S is a non-empty continuous set or S is the union of some non-empty continuous sets. Consider the following principle:

> DAUP-R2: Let *R* be a region of space. Let *S* be an eligible subset of **U** such that *S* has the same shape as *R*. Then for any eligible subset of *S*, *S*-, there is a region of space *R*- such that *S*- and *R*- have the same shape and *R*- is a part of *R*.

[37] In this context, to say that *M* is composed of arbitrary undetached parts is to say that there is a model of abstract space such that a subset *S* of its domain has the same shape as *M* and *M* has parts corresponding to the non-empty subsets of *S*.

[38] David Lewis appeals to a principle like this when arguing against *magical ersatzism*. See Lewis (1986): 179-183. It is possible that this principle needs to be qualified. Consider the *membership relation*, which relates objects to sets. Some material simples bear this relation to some singletons. Singletons may very well be simples. (See Lewis (1991) for an interesting development of this claim.) So any material simple may bear the membership relation to any singleton? Some may balk at accepting this claim. See van Inwagen (1986): 207-210. I am inclined to accept the unmodified principle.

[39] Two points of clarification: first, the claim that necessarily, no extended simple occupies a point-sized region of space is *not* analytic. It would be analytic if this claim were equivalent in meaning to the claim that necessarily, no extended simple is point-sized. These two claims are equivalent in meaning only if the Extrinsic Theory is itself analytic. But although I think that the Extrinsic Theory is true, I don't want to say that it is true by definition! Second, I do not endorse the *de re* claim that every extended simple is essentially extended. In fact, it should be clear that I reject this claim.

[40] See Sider (2001), sections 3.2-3.3.

[41] See Lewis (1986a): 202-205,210.

[42] Note that 'analyzable' is not to be equated with 'translatable'.

CHAPTER 4

MATERIAL ATOMLESS GUNK

4.1 Preliminaries

In the previous chapters, I argued that there is no non-mereological criterion for being a material simple and that extended material simples are possible. I now turn to the question of whether material atomless gunk is possible. I will argue that there is a reason to think that it is possible. One conception of material atomless gunk – the *Whiteheadian conception* – is consistent and conceivable. And there are no good arguments that this kind of material atomless gunk is impossible.

Although I hold that material atomless gunk is possible, I do not hold that gunky spacetime is possible. It is commonly thought that any gunky object must occupy a gunky region of spacetime. I will argue that this is not the case. Let us say that a region of space (or spacetime) is *simple* iff that region has no proper parts. A region of space is *gunky* iff every part of that region has proper parts. Let us call the maximal fusion of space (or spacetime) simply *space* (or *spacetime*). So spacetime is that region of spacetime that has all other regions as parts. Let us say that spacetime is *simplistic* just in case there are some simple regions, the *xs*, such that spacetime is the fusion of the *xs*.

There are three theses I wish to discuss. First, there is the *compatibility thesis* (CT):

> (CT): There are possible worlds with simplistic spacetime and there are possible worlds with gunky spacetime.[1]

Second, there is the *occupation thesis*:

> (OT): Necessarily, an object is material atomless gunk if and only if it occupies a gunky region of spacetime.

Third, there is the *gunky thesis*:

(MT): Material atomless gunk is possible.

My plan is as follows. First, I will argue that CT is false. Since I place more credence in the claim that simplistic spacetime is possible than I do in the claim that gunky spacetime is possible, I infer that gunky spacetime is impossible. However, the impossibility of gunky spacetime implies that MT is false only if OT is true. Fortunately, there are good reasons to reject OT as well. So one argument against MT is undercut at the beginning.

4.2 The Case Against CT

The case against CT is not airtight. In fact, there are a number of ways to undercut the argument against CT that are not without some initial plausibility. However, discussing these issues in sufficient depth to close off the ways of undercutting this argument would require more space than I presently have. Accordingly, I will do my best to acknowledge the potential weaknesses of the argument along the way and try not to overstate the case against CT.

The case against CT can be presented as follows:

(1) If a property or relation is natural to degree *n*, then it is necessary that the property or relation is natural to degree *n*.

(2) If CT is true, then there is a property such that (i) it is natural to degree *n* but (ii) it is not necessary that it is natural to degree *n*.

(3) So CT is not true.

The argument is valid. But the premises need a lot of unpacking. Let me begin by discussing premise (1). In chapter 2, when discussing the view I called Instance, I assumed that some properties are perfectly natural. Recall the roles that natural properties are employed to play: the natural properties and relations are those that account for *objective similarity*; if two things share a natural property, then they objectively resemble each other in that respect; perfect duplicates are objects such that there is a 1-1 correspondence between their parts that preserves perfectly natural properties and relations.

It is important for this argument that naturalness or objective similarity is not all or nothing; it is a matter of degree. *Being red* is a reasonably natural property, *being red or green* is much less natural, and there are properties far more unnatural than these. I assume that there are absolute facts about the degree to which a particular property is natural at a world and that these absolute facts about naturalness fix the facts about relative naturalness of various properties that are instantiated at a world. In other words, the fundamental notion is *P is natural to degree n*, and not *P is more natural than Q by degree n*. Properties that are natural to the maximal degree are called *perfectly natural*.

Premise (1) is a claim about the essential properties of properties. Everything, including properties, has essential properties. For example, the property of being a prime number has the property *being such that 2+2=4* essentially. Premise (1) asserts that the degree to which a property is natural is an essential feature of that property. So suppose charge is perfectly natural. It follows from premise (1) that charge has the property of being perfectly natural essentially. There is no world at which it fails to be perfectly natural.

4.2.1 A Defense of Premise (1)

Premise (1) states that, if a property or relation is natural to degree *n*, then it is necessary that the property or relation is natural to degree *n*. Since (1) makes a claim about the essential properties of properties, it would aid our evaluation of (1) if we were to have a theory about the transworld identity conditions of properties. Let us make our lives easier by assuming a plurality of possible worlds. We can now ask: do properties exist at multiple worlds? Or are properties world-bound? And, if properties are world-bound, is the appropriate semantics for the attribution of modal properties to properties a kind of *property counterpart theory* analogous to counterpart theory used to give a semantics for the attribution of modal properties to individuals? The answers to these questions will help us decide whether to accept or reject (1).

There are three main theories of properties. What it means to say that properties are world-bound differs importantly from theory to theory. The first view worth examining is the view that properties are *sets* or *classes* of their actual and possible instances. According to this view, a property is world-bound just in case there is a world *w* such that all of its elements exist at and only at *w*. A property enjoys *transworld existence* on this view just in case it has elements *x* and *y* such that *x* exists in one possible world and *y* exists in another possible world.

The second view worth examining is the view that a property is a *universal*, which is somehow wholly present in its instances. A property is world-bound according to this view just in case there is a world *w* such that it is wholly present only within *w*. A property enjoys transworld identity on this view just in case it is wholly present at different possible worlds.

Third, there is the view that properties are *tropes*, where a trope is a *particularized property*. On this view, the important notion of *world-boundedness* applies not to tropes *per se* but instead to maximal resemblance classes of tropes. A class *C* of tropes is a maximal resemblance class just in case (i) every trope in *C* perfectly resembles every other trope in *C* and (ii) no trope not in *C* perfectly resembles some trope in *C*. We now say that a maximal resemblance class of tropes *C* is world-bound just in case there is a world *w* such that every element of *C* exists at and only at *w*. A maximal resemblance class *C* enjoys transworld identity just in case some tropes in *C* exist in one world while different tropes in *C* exist in a distinct world.

If properties are literally present at more than one world, then it is intuitive that they carry their *natures* with them from world to world. One aspect of a property's nature is its *adicity*; whether a property is a one-place, two-place, etc. property is an intrinsic aspect of that property and not a function of its surroundings. The qualitative aspect of a property is also an aspect of its nature. To deny this seems to strip properties of the very things that make them properties. Finally, the naturalness of a property also seems to be a function of its nature and not the circumstances in which the property finds itself. So, if properties are transworld entities, it is reasonable to think that properties have the same nature at every world at which they exist. And, if properties are transworld entities, the way to understand *de re* modal claims about properties is via the following schema:

> Property *P* has property *Q* *essentially* just in case *P* has *Q* at every world at which *P* is exemplified.

So, if properties are transworld entities, it is reasonable to think that (1) is true.

However, those who hold that properties are world-bound entities have reason to be suspicious of (1). If properties are world-bound entities, then the natural way to analyze *de re* possibility claims about properties is via a kind of property counterpart theory. Although counterpart theory is typically employed only to analyze *de re* possibility claims about *individuals*, there is no reason why it cannot be employed to analyze *de re* possibility claims about properties as well. A counterpart relation is simply a relation of similarity; in order to understand how counterpart theory might work when applied to properties, we simply need to determine what the appropriate relation (or relations) of similarity is (or are).

As I see things, three factors could reasonably be said to be relevant to determining the relevant similarity relation. We can think of each factor as determining a kind of similarity relation. The appropriate counterpart relation for properties might be a blend of some of these similarity relations; alternatively, and perhaps less plausibly, each similarity relation could be thought as a counterpart relation.

The first factor that determines a similarity relation among properties is their natures. Consider the properties of being red, being orange, and being blue. Intuitively, *being orange* is more similar with respect to qualitative nature to *being red* than it is to *being blue*. Or consider spin, charge, and *being a bachelor*. Obviously, spin is more similar with respect to degree of naturalness to charge than it is to *being a bachelor*. Finally, consider *being ten feet from*, *being 10 years before*, and *being ugly*. *Being ten feet from* is more similar with respect to adicity to *being 10 years before* than it is to *being ugly*. Even if properties are world-bound, it could be that some properties at world *w1* are similar with respect to their natures to other properties at world *w2*.

Similarity with respect to nature would presumably be a blend of these three kinds of similarity and might perhaps count as one kind of counterpart relation that properties bear to each other:

> x is a counterpart$_N$ of y just in case x and y are similar with respect to their natures.

A second factor that could reasonably be thought to determine a counterpart relation among properties is *pattern of instantiation. Let* w be an arbitrarily chosen possible world. Let F be the proposition that is the conjunction of every atomic proposition p such that (i) p is an attribution of a fundamental property or relation to some thing or things and (ii) p is true at w. Let Q be the proposition that is derivable from F by first systematically substituting the propositional equivalent of free variables for each object that appears in F and then existentially generalizing over those variables.[2] We can think of Q as the *qualitative* description of w. We can say that two worlds are *qualitatively indiscernible* just in case their qualitative descriptions are identical.

Let us consider an arbitrarily selected possible world and its F proposition. Let S be the proposition that is derivable from F by systematically substituting the propositional equivalent of second-order free variables for each property that appears in F and then existentially generalizing over these variables. We can think of S as the *structural* description of w. Let us say that two worlds are *structurally indiscernible* just in case their structural descriptions are identical. The structural description of a world tells us the pattern of instantiation of the properties at that world without telling us the nature of the properties in that world. Structural descriptions tell us the various roles that properties play in the worlds described; moreover, there can be important similarities between the various structures described by these structural propositions. We can use this sort of similarity to cash out a kind of counterpart relation:

> x is a counterpart$_S$ of y just in case (a) x exists at w and y exists at w^*, (b) the structure of w is similar to the structure of w^*, and (c) the role x plays in the structure of w is similar to the role that y plays in the structure of w^*.

There is a third sort of similarity relation that the advocate of property counterpart theory can appeal to: similarity with respect to *nomological role*. Whatever laws of nature are, it is clear that they involve properties in some intimate way. For any world w, let $L(w)$ = the proposition that describes the lawful relations between the properties that exist at w. Let $L^*(w)$ be the proposition derivable from $L(w)$ by systematically replacing the properties with the positional equivalent of second-order free variables and then binding those variables with quantifiers. I will call $L^*(w)$ the *description of the nomological structure* of w. Descriptions of nomological structures tell us the various roles that properties play in the laws of the worlds described; and, like structural descriptions, there can be important similarities between the various nomological structures described by these propositions. These structures define a third sort of counterpart relation:

> x is a counterpart$_L$ of y just in case (a) x exists at w and y exists at w^*, (b) the nomological structure of w is similar to the nomological structure of w^*, and (c) the role x plays in the nomological structure of w is similar to the role that y plays in the nomological structure of w^*.

There is no reason to think that these three similarity relations must march in step, for the following scenario is epistemically possible: there are properties *p* and *q* that are located in worlds *w1* and *w2* respectively. Properties *p* and *q* are similar with respect to nomological role and hence bear one kind of counterpart relation to another. However, properties and *p* and *q* are not similar with respect to their natures. (For a more concrete example, consider two worlds in which charge and spin have switched nomological roles.)[3]

Suppose the advocate of property counterpart theory identifies the relation of nomological similarity with *the* counterpart relation defined on properties. Then the advocate of property counterpart theory can deny the first premise of the incompatibility argument. All that is needed is that a property can have a counterpart that differs with respect to how natural it is. And there is no reason to think that such a case cannot occur. This kind of property counterpart theorist should probably deny premise (1).

Suppose that the advocate of counterpart theory identifies the counterpart relation with some similarity relation that is determined by the three similarity relations that we have discussed. There is no reason to think that this "average" similarity relation marches in step with the relation of similarity with respect to nature. So perhaps this kind of counterpart theorist should deny premise (1) as well.

Suppose that the advocate of counterpart theory claims that there are multiple counterpart relations, some of which correspond to the ones that we have discussed. She may then wish to say that, in different contexts, we invoke different counterpart relations; in context *C*, a statement of the form *p is essentially F* is true just in case every property that bears the counterpart relation made salient in *C* to *p* is *F*. On this view, there will be some contexts in which the salient counterpart relation is the relation of nomological similarity. So, on this view, there will be contexts in which premise (1) is false.

So those who hold that properties are world-bound and so adopt counterpart theory have a good reason to be suspicious of (1) as well. On the other hand, those who hold that properties are transworld objects have a good reason to endorse premise (1). Although I can't hope to show that properties are transworld entities here, if I can show that there is an intimate connection between this issue and the possibility of gunky space, this in itself will be a significant result. Accordingly, I will now turn to an examination of the second premise.

4.2.2 A Defense of Premise (2)

One of the background assumptions needed to ensure the truth of premise (2) is the following:

(PS): Necessarily, r is an atomic region of spacetime iff r is point-sized.

(PS) rules out the possibility of extended yet simple regions of spacetime. But that's fine; I argued in chapter 3 that such regions are impossible. (PS) also rules out the possibility of unextended yet mereologically complex regions of spacetime. This also seems unobjectionable, although I don't have an argument against this possibility. Given (PS), spacetime is gunky if and only if spacetime has no point-sized proper parts.

The advocate of gunky spacetime may want to talk about points of spacetime even if she does not take them with full ontological seriousness. Points of spacetime can be modeled by sequences of regions of spacetime. Ersatz points may be thought of as an ordered set of regions *Rm* such that, (i) if *m* is less than *n*, then *Rn* is a part of *Rm*, and (ii) the diameter of *Rn* approaches zero as *n* approaches infinity. [Forrest (1996): 128]. These ersatz points aren't *real* points, since they do not belong to the same ontological category as regions.

This point about ersatz points not being real points is important. If we ignore it, we might think that we have a quick argument for premise (2). This argument would run like this: if spacetime is simplistic, then it decomposes without remainder into point-sized parts. These point-sized parts are real parts of spacetime. Presumably, the geometrical properties of a region of spacetime are fixed by the intrinsic character of and the relations instantiated by the parts of that region. But this seems to mean that being point-sized is a perfectly natural property, since the geometrical properties of a point are not fixed by the intrinsic character of or relations instantiated by its proper parts, since it doesn't have any. So, if spacetime is simplistic, then being point-sized is a perfectly natural property.

So far, so good. But the argument proceeds: if gunky spacetime is possible, then being point-sized is *not* perfectly natural, since to be point-sized in a gunky spacetime is to be a certain kind of defined sequence. It is here that we must abandon this argument. The mistake is straightforward but instructive: in a gunky spacetime, just as there are no spacetime points, *strictly speaking nothing instantiates the property of being point-sized either*. In a gunky spacetime, the property of being point-sized is not had by certain sequences of regions. Instead, certain sequences of regions have properties that allow them to "model" or "simulate" points. So the quick argument fails to support premise (2).

Nonetheless, the mistake is instructive, for it tells us what to look for. In order to support premise (2), we should find some property or relation that is perfectly natural in a world with one kind of spacetime but not perfectly natural in a world with a different kind of spacetime.

The kinds of properties we will look at when defending premise (2) are metrical features of worlds with simplistic spacetime and worlds with gunky spacetime. Perhaps similar examples that support premise (2) could be enumerated by attending to the more abstract projective or topological features of such spaces. I am inclined to think that there are possible worlds at which spacetime has topological and projective structure but lacks metrical structure. At such worlds, there are no facts about how distant objects are from each other. Perhaps there are also worlds in which spacetime has topological structure but no richer structure. Perhaps some of those worlds are worlds in which spacetime is gunky, while others are worlds in which spacetime is simplistic. It may be that, in these worlds, there are properties that could serve to motivate premise (2). Regardless, I will concentrate on worlds in which spacetime has metrical features as well.

Plausible candidates for motivating premise (2) are *diameter* and *distance*. If spacetime is simplistic, then the fundamental distance relations are two-place relations of the form *x is n units from y*. (Sometimes this relation is called *spacetime interval.*) The things that instantiate these relations are spacetime points. In simplistic spacetime, all facts about the geometry of spacetime follow from the facts about which points stand in which distance relations to each other and the facts about which points are parts of which regions. We can, for example, determine the diameter of an open sphere once we know the facts about which points are parts of the sphere and the distances these points bear to each other. The procedure is straightforward: assume that the set of point-sized parts of the open sphere is *S*. The diameter of our open sphere is *n*, where *n* is the smallest number such that, for any two members of *S*, the distance between them is less than *n*. Similarly for closed spheres: the diameter of a closed sphere is *n*, where *n* is the smallest number such that, for any two point-sized parts of the closed sphere, the distance between them is less than or equal to *n*.

So, in a simplistic spacetime, the various determinate properties of the determinable *being a sphere with a diameter of n units* are not perfectly natural properties. They are less than fully natural, since they can be defined in terms of parthood and the distance relations obtaining between points.

What about the distance relations obtaining between non-overlapping regions? There are two sorts of distance relations between regions that we might be interested in, both of which can be defined in a straightforward way if spacetime is simplistic. First, there is the *maximal distance relation*. For closed regions, regions r1 and r2 are maximally distant by *n* units just in case r1 has a point-sized part that is *n* units from some point-sized part of r2, and r1 has no point-sized part that is further than *n* units from any point-sized part of r2. For open regions, regions r1 and r2 are maximally distant by *n* units just in case *n* is the least upper bound of the distance relations instantiated by point-sized parts of r1 and r2. Second, we might be interested in the *minimal distance relation*. For closed regions, regions r1 and r2 are minimally distant by *n* units just in case r1 has a point-sized part that is *n* units from some point-sized part of r2, and r1 has no point-sized part that is closer than *n* units to any point-sized part of r2. For open regions, r1 and r2 are minimally distant by *n* units just in case *n* is the greatest lower bound of the distance relations instantiated by point-sized parts of r1 and r2. (Obviously, other similar distance relations between regions can be defined.)

(What if the regions in question overlap? If we like, in those cases, we may say that both the minimal and the maximal distances between those regions is zero.)

Neither the determinates of *r1 is maximally distant by n units to r2* nor the determinates of *r1 is minimally distant by n units to r2* are perfectly natural given that spacetime is simplistic, since both are definable in terms of parthood and the distance relations obtaining between points.

What if spacetime is gunky? The standard construction of ersatz points mentioned earlier appeals to the notion of *diameter*. [Forrest (1996)]. Once we assume that spherical regions have diameters of various lengths, we can construct ersatz points. We can even, if we like, assign ersatz distances to the ersatz points, for there are functions that take ordered pairs of points to real numbers that satisfy the constraints on being a distance function. But we shouldn't think that these ersatz distance relations that ersatz points bear to each other are *genuine* distance relations. Ersatz points are not parts of space, nor are they related via real spatial relations to real parts of space.

In fact, it is a kind of a category mistake to suggest that ersatz points are related to each other via real distance relations. I think that we can see that this is so in a particularly vivid manner if we attend to the fact that we can "construct" ersatz points that are equally suitable for our purposes without appealing to set theory. For example, instead of identifying points with certain ordered sets, we could identify ersatz points with certain *propositions*. On this way of "constructing" "points" from regions, points may be thought of as propositions that state that there are concentric spheres of ever-shrinking diameter that are parts of each other. Each point could, if we like, be "identified" with a proposition that states of some series of regions that they are concentric, have their predecessors as parts, and are such that the limit of the diameters of these regions is zero. No one would take seriously the claim that these "points,", which really are propositions about regions and their properties, are actually distant from one another or located in space. No proposition does or can bear any distance relation to any other. The distance relations that link points to each other in a simplistic spacetime are not instantiated by ersatz points in a gunky spacetime.

So, when defining minimal and maximal distance between regions in a way that reveals what is metaphysically significant about gunky spacetime, we shouldn't make use of the notion of distance between points. Doing so will not provide us with a perspicuous account of which metrical features are basic.

It seems that the fundamental metrical facts in gunky spacetime are about the diameters of certain spherical regions. This is not surprising. Just as in a simplistic spacetime every region of spacetime decomposes without remainder into points, in a gunky spacetime every region of spacetime decomposes without remainder into non-overlapping spherical regions. The various determinables of *having a diameter of n units* seem to be basic in worlds with gunky spacetime, i.e., perfectly natural.

What about the distances between regions? We might hope that we could account for the various distance relations between regions in terms of the diameters of larger spherical regions that encompass them. Let us explore whether this sort of account is satisfactory for the two sorts of distance relations between regions that we have discussed, minimal and maximal distance.[4] We will start by trying to characterize the *minimal distance relation* in a gunky space. As before, we assume the regions in question do not overlap. (If they do overlap, we can assume that the minimal and maximal distances between them is zero.) We will need the following notion and definitions:

Notation:

D(x) = *n*	the diameter of *x* is *n*
x<y	x is a proper part of y
xoy	x overlaps y

Definitions:

x and *y* are *concentric* =df.:

Either: (i) x<y and,
(ii) Let *n* be the diameter of some sphere S such that S<y but ~Sox and there is no sphere S’ such that D(S’)>D(S) and S’<y and ~S’ox. Then there are at least two spheres such that the diameter of these spheres is *n*, both spheres are a part of *y*, and neither sphere overlaps *x*.

Or: (i) *y*<x and,
(ii) Let *n* be the diameter of some sphere S such that S<x but ~Soy and there is no sphere S’ such that D(S’)>D(S) and S’<x and ~S’oy. Then there are at least two spheres such that the diameter of these spheres is *n*, both spheres are a part of *x*, and neither sphere overlaps *y*.

Informally, concentric spheres are centered around the same point in spacetime.

A spherical region *o barely avoids* region *r* =df. (i) *r* does not overlap *o* and (ii) any sphere larger than, but concentric with, *o* overlaps *r*.

Informally, regions that barely avoid each other are touching. The notion of bare avoidance is accordingly a topological notion.

We can now define minimal distance in a gunky space as follows:

(MinDG): The minimal distance between *r1* and *r2* is *n*, where *n* is the diameter of the smallest sphere that barely avoids both *r1* and *r2*.

In order to define *maximal distance* in a gunky spacetime, we need the following additional definition:

> A spherical region *S barely contains* regions *r1* and *r2* =df. (i) *r1* is a proper part of *S*, (ii) *r2* is a proper part of *S*, (iii) there is no spherical region S2 such that S2 is concentric with S, D(S2)<D(S), and *r1* and *r2* are proper parts of S2.

Informally, if a spherical region barely contains a region, then that region is pressed against the inside surface of the sphere. Were that region any larger, it would burst forth from the sphere.

Now that we have the notion bare containment, we can introduce the notion of maximal distance as follows:

> (MaxDG): The maximal distance between *r1* and *r2* is *n*, where *n* is the diameter of the largest spherical region that barely contains *r1* and *r2*.

When formulating the definitions of minimal and maximal distance, we needed to appeal to facts only about parthood and diameter. This provides further reason to think that diameter is the fundamental metrical notion in a gunky spacetime. However, there is a worry about these definitions that is worth discussing. For, if this worry is genuine, it may be that the gunky theorist needs to take the facts about relations minimal and maximal distances as basic metrical facts as well.

The definitions of minimal and maximal distance are acceptable provided that we have a guarantee that, for any two non-overlapping regions, there is some larger spherical region that barely contains both. If this is always the case, facts about minimal and maximal distance can be cashed out in terms of facts about diameter and parthood in the manner we just explored. But why should we assume that this is always the case?

Elsewhere, I have argued that there are certain discrete spaces at which objects bear directly various distance relations to each other even though there are no intervening regions of space. [McDaniel (forthcoming)]. For example, there are possible worlds in which there are exactly two spatial points *p1* and *p2* that are 10 feet from each other, despite the lack of intervening space. Why not then also allow for gunky spaces at which various gunky regions of space directly bear various distance relations to each other? At such a world, two gunky spheres might have a minimal distance of 10 feet from each other and a maximal distance of 15 feet from each other even though there are no larger spheres that have both of them as proper parts. They simply directly bear these distance relations to each other.

If this is possible, then the definitions of minimal and maximal distance are not adequate. There are worlds at which they give incorrect results. And, if these definitions are not adequate, then it seems to me that the gunky theorist must take the notions of minimal and maximal distances as additional primitive notions. But then the gunky theorist must say that, in gunky space, these notions pick out perfectly natural relations. For the relations that they pick out are not instantiated in virtue of any deeper metrical facts.

I have argued that facts about the diameters and distances between regions are facts about perfectly natural properties and relations in worlds with gunky spacetime but are not facts about perfectly natural properties and relations in worlds with simplistic spacetime. So it seems that the distance relations and the diameter properties in worlds with simplistic spacetime have a degree of naturalness that they do not have in worlds with gunky spacetime. If this is the case, then premise (2) is true. I will now look at possible rejoinders to the argument for premise (2).

Rejoinder one: it is true that the properties had by regions of gunky spacetime that are instances of the determinable *having a diameter of n units* are perfectly natural. It is also true that the properties had by regions of simplistic spacetime that are instances of the determinable *having a diameter of n units* are not perfectly natural. But these are not the same determinate properties. In gunky spacetimes, regions enjoy one kind of diameter property; in simplistic spacetimes, regions enjoy a different kind of diameter-property. For example, there are exactly two determinate properties that go by the name *having a diameter of 10 feet*. One of those properties is instantiated only in worlds with simplistic space; the other is instantiated only in worlds with gunky space. And so your argument for premise (2) fails.

Response to rejoinder one: this rejoinder violates a necessary truth about determinates and determinables. Properties *p* and *q* are determinates of the same determinable only if *p* is equally as natural as *q*. Compare the various determinate mass properties. Each is as natural as the others. Or consider the various and yet equally natural determinates of charge. So this rejoinder fails.

Rejoinder two: it is true that the properties had by regions of gunky spacetime that we call *having a diameter of 10 feet, having a diameter of 11 feet,* etc. are perfectly natural. It is also true that the properties had by regions of simplistic spacetime that we call *having a diameter of 10 feet, having a diameter of 11 feet,* etc. are not perfectly natural. But these are not the same properties. Why do we call them by similar names? The answer is straightforward: because they behave in similar-sounding ways. They are similar with respect to their structural role, and this similarity is why it makes sense to call them by similar names. Note that this rejoinder does not require adopting counterpart theory for properties.

Response to rejoinder two: Suppose that the properties are similar with respect to their structure. Then I am happy to let you call these properties by similar names. But I would have been happy to let you call these properties by similar names even if they hadn't been similar with respect to their structure. What's in a name, after all? But structural similarity comes cheap. I assume that there are worlds in which *mass* is similar with respect to structure to "gunky diameter." In such a world, mass comes in continuous quantities. Whenever an object enjoys *n* units of mass, it has a proper part that enjoys fewer than *n* units of mass. Using the mereological notions of parthood and overlap and the concept of mass, we can define "mass concentricity," "minimal mass distance," etc., if we like. But our doing this does not make mass-distance into genuine distance. And, more importantly, *it does not make the things that it relates regions of spacetime*, although of course you can call these things "regions" if you like. Real spherical regions have real diameters, not fake diameters that behave similarly with respect to their structural role. This rejoinder requires us to say that a gunky spacetime is not a genuine spacetime.

Rejoinder (3): The various properties of *having a diameter of n units* are *functional* or *multiply realizable* properties. Functional properties are always realized by other properties. For example, many philosophers take the property *thinking about blue skies* to be a functional property. According to these philosophers, objects of all sorts can have this property, provided that their parts bear the right sort of functional relations to each other. Robots, ectoplasmic spirits, and human beings all can have this property, although the relational structure that underwrites it differs in each case. Call the various properties of having these relational or functional properties the *realizing properties*. The realizing properties can differ with respect to how natural they are and nonetheless realize the same property. Perhaps being an ectoplasmic spirit in state *C* is a perfectly natural property, whereas being a human being enjoying brain state *B* is a less than perfectly natural property. It does not follow that the property *thinking about blue skies* is more natural in worlds in which the property is realized by ectoplasmic spirits in state *C* than in worlds in which the property is realized by human beings enjoying brain states *B* .

Similarly, there are various properties that underwrite *having a diameter of 10 feet* in a gunky spacetime. And there are various properties that underwrite *having a diameter of 10 feet* in a simplistic spacetime. These properties differ with respect to how natural they are. But the functional property *having a diameter of 10 feet*, which is instantiated in both worlds, does not differ with respect to how natural it is.

Response to rejoinder (3): If *having a diameter of 10 feet* is a functional property, then it is realized in a world in which mass (or some other property) plays "the diameter role" in the fashion described in the response to rejoinder (2). But there is no reason to assume that such a world is a world in which things stand in various distance relations to each other. Perhaps there are no genuine spatiotemporal relations in that world.

Second, spatiotemporal properties are not functional properties. To think of them in this way to ignore their qualitative aspects. Following Galen Strawson, I want to say:

> I am tempted to hold up my hands, like G. E. Moore, and to consider, not my hands, but the space – by which I mean only the spatial extension – between them, and to say: 'This is space (spatial extension), and it is real, and I know its nature, in some very fundamental respect, whatever else I do not know about it or anything else (e.g. the fact that it is an aspect of spacetime)'. On this view the ordinary concept of space, or indeed the concept of spacetime, in which (I claim) a fundamental feature of our ordinary conception of space survives, has correct non-structural descriptive content. It does not relate only to 'what we may call the causal skeleton of the world', if to say this is to say that it does not capture any aspect of the non-structural nature of the world. It has non-structural content, and can transmit this content to our more general conception of the non-mental. [Strawson (2003): 57].

It is the spatiotemporal properties themselves that have the qualitative aspect and not some deeper properties that "realize them."

Rejoinder (4): Why not simply say that the various diameter properties are perfectly natural in both worlds with gunky spacetime and in worlds with simplistic spacetime? That undercuts the argument as well.

Response to rejoinder (4): One worry about this response is that it seems to require necessary connections between certain perfectly natural properties and relations instantiated in worlds with simplistic spacetime. Suppose that *having a diameter of 10 feet* is perfectly natural in worlds with simplistic spacetime. Presumably, the various distance relations instantiated by points in simplistic spacetimes are also perfectly natural. But then there is a necessary connection between two distinct sets of perfectly natural properties and relations. For suppose there is a continuous region such that something is a (point-sized) part of it if and only if it is (a point-sized region) less than

10 feet from some point *x*. (That is, suppose that this region has parts that stand in certain perfectly natural relations to each other.) It follows as a matter of necessity that this region instantiates *having a diameter of 10 feet*. Suppose that a region decomposes without remainder into points and instantiates *having a diameter of 10 feet*. It follows, as a matter of necessity, that this region has parts that stand in certain perfectly natural relations to each other.

If rejoinder (4) is correct, then there are necessary connections between perfectly natural properties and relations. But this sort of necessary connection is unacceptable to a Humean like myself.

I conclude that premise (2) stands. This completes my argument against (CT). I will now look at some of the consequences of rejecting (CT).

4.3 Should We Reject Simplistic Spacetimes?

If (CT) is false, then either gunky spacetime is impossible or simplistic spacetime is impossible. It seems to me that we have reason to give more credence to the claim that simplistic spacetime is possible. But perhaps this is simply a prejudice. Perhaps instead there are good reasons to have the opposite preferences. We will now examine one argument for the claim that we should prefer gunky spacetime.

In a recent article titled "From Ontology to Topology in the Theory of Regions,", Peter Forrest argues for gunky space. [Forrest (1996)]. Forrest's case for gunky space is based on two assumptions that he discusses at the beginning of the article. The first assumption is that space is continuous. The second assumption is that we are to adopt realism about regions of space, points of space, or both. [Forrest (1996): 34]. I will argue later that, if continuous gunky space is possible, then something like *discrete* gunky space is also possible. So the first assumption could possibly be dropped. (We will return to this issue later.) Since I accept spacetime realism, I won't challenge the second assumption.

Forrest discusses three possible versions of spacetime realism. First, there is the *points only ontology* (POO), according to which there are spacetime points but no spatial regions. Instead, there are "substitute regions," which are *sets* of points of space. (We can think of any set of spacetime points as a substitute for a region of space.) These aren't genuine regions of space, since they belong to a different ontological category than the spacetime points.

Second, there is the *regions only ontology* (ROO), according to which there are regions but no spatial points. Instead, there are "substitute points," which are *sequences* of successively smaller spherical regions nested around the "points". (We can think of these sequences as representing the *limits* of regions of space.) I assume that, according to ROO, there are no *lines* or *planes* of space either, although Forrest does not explicitly say this.

Third, there is the view I favor, the *points and regions ontology* (PRO), according to which there are spatial points and spatial regions. Spatial regions are simply sums of points of space. It is hard to see why anyone would seriously favor POO over PRO. Once we have points of space, given classical mereology we have the regions as well. Although the universal summation principle of classical mereology is controversial, its application to points of space is not the source of its controversy. Here, it seems harmless. And, once we have sums of points, is there any reason not to think that these are regions? I can think of none. I will henceforth ignore POO in what follows.

Accordingly, the choice facing us is between ROO and PRO. Let us now attend to Forrest's argument for ROO (and hence against PRO). Forrest's argument for ROO has two premises. Forrest calls the first premise the *Probability Premise*. He writes:

> The Probability Premiss states that in the best scientific theory we would not assign point locations (or momenta) to particles, or consider values of fields at point locations. We would instead assign probabilities to regions. [Forrest (1996): 34-35].

Forrest's basic idea seems to be this. Given that we are scientific realists, we should accept the ontological commitments of our best scientific theories. The best scientific theory is one in which an ontological commitment to regions of spacetime is made. It is not clear, however, that the regions that our best scientific theory speaks of need to be construed as other than sets of points. On this possibility, Forrest writes:

> My objection is based on a rather general principle concerning set-theoretic constructions, namely that when assessing a theory we must not be beguiled by the apparent simplicity conferred by the mathematical technique of nested definitions. That is, we should unpack the definitions to arrive at the full description according to the theory. .... Applying this general principle to the case in hand, we should be reluctant to treat regions as sets of points if in the formulation of our theory we are considering assignments of probabilities to regions. For assignments of probabilities to sets of points, if points are considered fundamental, are more complicated than assignments to regions, if these are considered fundamental. For the same reason, if the statement of our theory were to require assignments of numbers to points, then we should be reluctant to endorse a regions-only ontology, for on that ontology points are constructed as sets of regions. [Forrest (1996): 36].

I have reproduced almost the entire passage since the argument here is especially opaque. I am guessing that the main thrust here is that physical properties should not be assigned to mathematical objects. So, if we have a theory that appears to assign physical properties to mathematical objects, such as sets or sequences, what the theory is really doing is assigning complicated relational structures to the elements of the sets or sequences. And these complicated relational structures are more complicated than the simpler properties that we thought the theory was assigning. If this is Forrest's point, then I think that something like this is right. Mathematical objects, such as sets or sequences, simply are not the right sort of thing to bear physical quantities. We can, if we like, speak as if they have them, for example, when we say that a set of things is located where its members are. But we shouldn't take this sort of talk to be asserting fundamental facts about the world.

However, as I mentioned, my interpretation of Forrest's argument here is little more than a guess. And one problem with this interpretation of Forrest's argument is that he says some things that suggest that he does not take the assignment of probabilities to regions to be analogous to the assignment of other fundamental quantities. For example, he writes that the probabilities being assigned need not be genuine probabilities. They could instead be measures of degrees of truth or analyzable as idealized relative frequencies. [Forrest (1996): 35]. Given this fact, it is hard to see why an assignment of, e.g., an idealized relative frequency to a set of points is any more complicated than an assignment of an idealized relative frequency to a region composed of the same points.

Forrest provides a second argument against taking the regions that are assigned probabilities to be sets of points:

> either we have an ad hoc restriction on which regions are assigned probabilities or we have an ad hoc restriction on which sets of points are regions. For we can assign probabilities only to *measurable* sets of points… [Forrest (1996): 37].

This argument also seems weak. First, given POO, there is no reason to claim that some non-empty sets of points don't count as regions. But the fact that only measurable sets can have probabilities assigned to them provides a completely non-ad-hoc reason for not assigning probabilities to them.

Forrest's argument against POO seems unsuccessful. Nonetheless, it may be that our best scientific theory requires either real regions or regions taken as sets of points. In the former case, we have a commitment to real regions of space. In the latter case, we have a choice between POO and PRO. But, as I argued earlier, there is no reason to prefer POO to PRO and some reason to have the opposite preference. So if our best scientific theory requires regions of some sort, we might as well take them to be real regions.

Let us now turn to Forrest's second premise in his argument for gunky space. Forrest describes his argument against points as an Ockhamist argument:

> the most straightforward Ockhamist argument against [PRO] concerns the number of entities being posited. We should show some preferences for smaller infinite numbers over larger ones. … One of the attractions of a regions-only ontology, even apart from the Probability Premiss, is that we might in fact propose that there are only beth-zero regions, an economy achievable on rival theories only if space is discrete. On more conservative versions of the regions-only ontology we shall have beth-one many regions, *represented* by countable unions of spherical sets which have rational coordinates for the centers and have rational radii. On the rival points-and-regions ontology, there are, however, beth-two regions obtained by summation from the beth-one many points. [Forrest (1996): 37-38].

Since PRO commits us to more things than ROO, and these additional things are not part of the explicit ontological commitment of our best scientific theory, we should prefer ROO.

Of course, it's not clear that Ockham's razor has a real application here. One could argue that Ockham's razor tells us not to multiply *types* of things beyond necessity, but it does not require us to not multiply *tokens* beyond necessity. And, since points belong to the same ontological category as regions and regions are simply sums of points, PRO does not violate Ockham's razor.[5]

A second worry about Ockham's razor is this. Even if we understand Ockham's razor as a maxim against postulating unnecessary tokens of things as well as types, it is clear that we need to understand it as telling us not to postulate unnecessary *distinct* things. For it seems reasonable to hold that, if we make an ontological commitment to some entity, our belief in the entity's parts does not constitute a further ontological commitment. And these points are simply parts of the regions to which we are already committed.

I conclude that Forrest's argument for gunky spacetime is at best inconclusive.

4.4 What about Material Atomless Gunk?

I have argued against (CT) and argued that an alleged reason to disbelieve in the possibility of spacetime points is not genuine. I have indicated (but not justified) my preference for the necessity of simplistic spacetime over the necessity of gunky spacetime. Accordingly, I am committed to:

(NP): Necessarily, every spacetime is simplistic.

I will now discuss the occupation thesis, which, recall, is the following:

(OT): Necessarily, an object is material atomless gunk if and only if it occupies a gunky region of spacetime.

(NP) and (OT) jointly imply the impossibility of material atomless gunk. However, I will argue that (OT) is false. (NP) by itself does not imply that material atomless gunk is impossible.

The case for material atomless gunk is not strong but it is not non-existent. The fact that we have a coherent conception of atomless gunk provides some reason to think that some possible object meets this conception. However, this evidence is defeasible. If a strong case can be made against material atomless gunk, then the evidence will be trumped. Accordingly, I will examine an argument due to Hud Hudson for the claim that material atomless gunk is impossible. I will argue that Hudson's argument fails. Perhaps material atomless gunk is impossible, but we have not yet seen a reason to think that it is. The weak case for atomless gunk as if yet undefeated. This will complete my case against (OT).

4.4.1 The Simple Question and the Occupation Thesis

In chapter 2 we examined various answers to the Simple Question. I will now discuss what these answers imply about OT. I will begin by discussing views that imply that OT is false.

We start with the Maximally Continuous View of Simples (MaxCon). MaxCon implies that OT is false, for, if MaxCon is true, then there could be an object that occupies a gunky region of space and yet is a simple. Recall that MaxCon states that an object is a simple just in case it occupies a maximally continuous region of space. A region of gunky space could be continuous and filled with matter. Any such region that is also maximal is then a region filled with a simple, given MaxCon.

Let us consider the Instance of a Fundamental Property View of Simples (Instance). Instance also seems to imply that OT is false. Consider an object that exactly occupies an extended region of gunky space. There is no principled reason why such an object could not instantiate a perfectly natural property. But then, given Instance, this object would be a simple.

Let us consider the Physical Indivisibility View of Simples (PIV). Presumably, if gunk is possible, there are some gunky worlds in which physically indivisible objects reside. These objects are counter-examples to OT, given PIV.

Three of the seven views discussed in chapter 2 imply that OT is false. Unfortunately, this doesn't show that OT is false, since I argued that each of these three views is itself false. However, I hope that the recognition that several plausible answers to the Simple Question do have this implication helps to loosen OT's grip on our intuitions.

What about the other answers to the Simple Question? The Brutal View of Simples, which I favor, is silent on the question of whether OT is true. Independence also seems to offer no help on this question. The Pointy View might seem to imply OT, but in fact is consistent with the denial of OT. We will return to this issue later.

I conclude that we should be very cautious before endorsing OT.

4.4.2 Zimmerman's Argument For Material Atomless Gunk

In Zimmerman (1996), Dean Zimmerman argues that material atomless gunk is possible. Strictly speaking, Zimmerman's conclusion is stronger than the mere claim that material atomless gunk is possible: he argues that, necessarily, any continuous material object must have some gunky part. Given that there are worlds with continuous material objects, it follows that material atomless gunk is possible.

Zimmerman, following Richard Cartwright, employs the following definitions:

> R is an *open sphere* about p = df. the members of R are all and only those points that are less than some fixed distance from p.
>
> p is a *boundary point* of R =df. every open sphere about p has a non-null intersection with both R and the complement of R.
>
> R is a *closed region* =df. R contains all of its boundary points.
>
> R is an *open region* =df. R contains none of its boundary points.
>
> R is a *partially open region* =df. R contains some but not all of its boundary points.[6]

Zimmerman then introduces the following definitions:

> (D1): Object *x* is *adjacent to region R* =df. the region exactly filled by *x* has no points in common with *R*, and the union of the two regions is a connected region.

(In a parenthetical remark immediately following the statement of D1, Zimmerman notes that *disconnected* regions are those separated by at least a point that is included in neither region, while connected regions must not be even that far apart.)

> (D2): *x* is a *closed object* =df *x* is a spatially located object; and, for every *y* such that *y* is a part of *x* adjacent to a region which is not filled by a part of *x*, there is a set A of simple parts of *y* such that each member of A is adjacent both to regions filled by parts of *x* and by regions not filled by any part of *x*.
>
> (D3): *x* is an *open object* =df *x* is a spatially located object; *x* has proper parts; and there is no set of simple parts of *x* such that each member is adjacent both to regions filled by parts of *x* and regions not filled by any part of *x*.
>
> (D4): *x* is a partially open object =df *x* is a spatially located object; *x* has proper parts; *x* is neither open nor closed. [Zimmerman (1996):6-7].

Definitions (D2)-(D4) employ both mereological and topological concepts, and the concept of *occupation*. Zimmerman notes that, if we assume the Pointy View of Simples, it follows that an object is closed if and only if it exactly occupies a closed region of space. Zimmerman also notes that, if we assume that, necessarily, all continuous material objects decompose without remainder into point-sized simples, it follows that an object is open if and only if it exactly occupies an open region of space.[7]

However, as Zimmerman points out, if we allow for the possibility of atomless gunk, it is not true that an object is open if and only if it exactly occupies an open region of space. Specifically, given Zimmerman's definitions, a gunky object could occupy a closed region of space. Zimmerman's view leaves open the possibility, which was also discussed in chapter 3, that an object could occupy a region and yet have a different mereological structure than the region it occupies. A closed region of space contains simple parts; a gunky object that occupies it need not.

What happens if we drop the assumption that all and only material simples are point-sized? It was this assumption that grounded the equivalence between being a closed object and exactly occupying a closed region. If we allow for extended simples, what changes?

It is clear that no extended simple can be an open object. For it is part of the definition of *open object* that open objects have proper parts. However, it is not part of the definition of *closed object* that closed objects have proper parts. (This is important, since all point-sized objects are closed given Zimmerman's definition.) Suppose an extended simple O exactly occupies region R. It follows then that O is a spatially located object. And, since O has no proper parts, the set of simple parts of O contains only O. (The set of proper parts of O is the empty set.) Given this, it emerges that O is a *closed object*, since O is such that, if O is adjacent to a region that is not filled by O, then O is adjacent both to regions filled by O and by regions not filled by O. Note that O will count as a *closed* object given Zimmerman's definitions even if O exactly occupies an open region of space. This is strange: all extended simples are closed objects, given Zimmerman's definitions, even if they exactly occupy an open region of space.

Zimmerman's definitions of *closed* and *open* objects obscure another question: what are the topological properties of the objects that occupy regions of space? Material objects can have shapes, just as regions of space can have shapes. One aspect of a region's shape is its topological structure, e.g., whether it is continuous, open, etc. Likewise, one aspect of a material object's shape is its topological structure. On Zimmerman's view, do material objects inherit the shapes of the regions they exactly occupy? Or can these two kinds of shape properties come apart?

Given the Extrinsic Theory, which I argued for in chapter 3, a material object is *topologically closed* just in case it occupies a closed region of space. Likewise, a material object is *topologically open* just in case it occupies an open region of space. It is clear that Zimmerman holds that some shape properties of objects match those of the regions they occupy, e.g., the volume of an object is equal to the volume of its region. But, on Zimmerman's view, can a material object be *closed* in Zimmerman's sense and yet still be topologically open, because it is an extended simple that exactly occupies an open region of space? On Zimmerman's view, can a material object be *open* in Zimmerman's sense because it is material atomless gunk and yet be topologically closed because it exactly occupies a closed region of space? We are left without clear guidelines of how to answer these questions.

There are other strange features of Zimmerman's definitions of *open object* and *closed object*. For example, given these definitions, there are possible worlds that contain an object that is both open and closed. (These objects, accordingly, are *not* partially open.) Consider a possible world in which space is finitely extended, that is, there is a maximally large region of space, which has finite extent. Consider a material object O that has proper parts and exactly occupies this maximal region of space. O is *closed* since O is spatially located and the second condition for being closed is vacuously satisfied. The reason why the second condition is vacuously satisfied is that there is no *y* that is a part of O that is adjacent to a region not occupied by O or a part of O. Similarly, O is an *open* object, since O is spatially located, has proper parts, and the third condition for being open is vacuously satisfied. The reason why the third condition for being an open object is vacuously satisfied is that there are no regions adjacent to O that do not contain O or a part of O. So there is no set of simple parts of O such that each member is adjacent both to regions filled by parts of O and regions not filled by any part of O. Note that this result was achieved without assuming whether the region exactly occupied by O is a topologically open region or a topologically closed region. So, presumably, there are worlds in which space is finite and in which the maximal region of space is topologically closed and exactly occupied by a material object that is both open and closed. Similarly, there are worlds in which space is finite and in which the maximal region of space is topologically open and exactly occupied by a material object that is both open and closed.

This is a strange result. Zimmerman's claim that, given the Pointy View of Simples and the rejection of atomless gunk, an object is closed (open) if and only if it exactly occupies a closed (open) region of space, is false. In worlds with finite matter-filled space, these equivalences do not hold. However, this is an admittedly unusual case, and this feature of Zimmerman's view does not seem to play a crucial role in anything in the argument that follows.

Let us now turn to Zimmerman's argument for the possibility of atomless gunk:

(1) If extended objects could be entirely composed of simples, then either (i) necessarily, every extended object is closed, (ii) necessarily, every extended object is open, (iii) necessarily, every extended object is partially open, or (iv) some "mixed bag metaphysics" is true.

(2) Alternatives (iii) and (iv) are impossible.

(3) If (ii) were true, then extended objects could not be composed entirely of simples.

(4) If (i) were true, then extended objects could not be composed entirely of simples.

(5) So, if extended objects could be composed entirely of simples, then they could not be composed entirely of simples.

:. Therefore, extended objects could not be composed entirely of simples.

By a “mixed bag metaphysics,” Zimmerman means a metaphysics that allows for the compossibility of some of the following: partially open objects, open objects, and closed objects.

Zimmerman assumes the following propositions:

(Matter): Necessarily, if *x* and *y* are material objects, then it is not possible for *x* and *y* to exactly occupy the same region of space (at the same time). [Zimmerman (1996): 2-4].

(A) The Doctrine of Arbitrary Undetached Parts. [Zimmerman (1996): 8].

(B) If two objects are in contact, then it is impossible for two distinct non-overlapping objects to be closer together than the two objects in question. [Zimmerman (1996): 9].

(C) For any two possible shapes of a part of the surface of an extended object, it is possible for there to be extended objects having surfaces with those shapes that are in contact. [Zimmerman (1996): 10].

(D) For every extended object *x* that fills a connected region, if extended objects *y* and *z* are discrete proper parts of *z* such that every part of *x* is a part of the sum of *y* and *z*, then *y* and *z* are in contact. [Zimmerman (1996): 10].

(B) and (D) seem relatively harmless, and I have nothing to say against them. I have already discussed and criticized DAUP in chapter 3 and will not revisit those criticisms. I will focus my critical comments on (Matter) and (C) before examining the role that each of Zimmerman’s assumptions plays in motivating the premises of his argument.

Let's begin with a discussion of (Matter). There are two ways to understand (Matter). We can take (Matter) to be a synthetic metaphysical claim about the nature of material objects. Alternatively, we can understand (Matter) as a stipulative definition, one that imposes a constraint on what it is to called a *material object*.[8] If we adopt the former route, we can directly argue against this principle. This is the route that I took in chapter 2, where I argued that there are good reasons to believe that co-located material objects are possible.

On the other hand, if we adopt the latter route, we cannot claim that (Matter) is false. We can, however, argue that nothing satisfies the definition of "material object" that (Matter) partially fixes. In fact, I think a stronger claim is correct: necessarily, nothing satisfies this stipulative definition. Given this partial definition of "material object," there could be no material objects. Accordingly, one would have no good reason to introduce this definition to begin with. You can say it if you want to, but why would you want to?

We need to distinguish the following two claims:

(1) Necessarily, no two material objects occupy the same space at the same time.

(2) If x is a material object and y is a material object, then it is necessary that x and y do not occupy the same space at the same time.

If we understand (Matter) to be equivalent to (1), then (Matter) is an acceptable stipulation in the sense that it is possible for objects to count as material objects. Compare (1) and (2) with the following:

(3) Necessarily, no two bachelors are married to each other.

(4) If x is a bachelor and y is a bachelor, then it is necessary that x and y do not marry each other.

Since it is part of the meaning of the word "bachelor" that bachelors are unmarried, but not part of the meaning of the word "bachelor" that bachelors are *essentially* unmarried, something can be a bachelor. (3) is an acceptable stipulation. (4), however, is clearly false, if understood not as a stipulative definition, and clearly unacceptable if understood as a stipulation, for nothing could have an essence that is impossible to have. There are no objects that are *essentially* bachelors. And, moreover, there couldn't be.

The important thing to note is that Zimmerman intends that (Matter) be interpreted as (2), not as (1). And (2) is analogous to the unacceptable (4), not the acceptable (3). Finally, the considerations discussed in chapter 2 for the claim that material objects can interpenetrate also suffice to make (2) an unacceptable stipulation. Since nothing can have an essence that is impossible to have, if we require that objects be essentially impenetrable to count as material objects, we in effect eliminate the possibility of there being material objects. This would be a strange thing to do.[9]

Let us now turn to (C), which states that, for any two possible shapes of a part of the surface of an extended object, it is possible for there to be extended objects having surfaces with those shapes that are in contact. Zimmerman's informal statement of (C) is that extended objects are not kept from touching one another simply because of their shapes. [Zimmerman (1996): 9].

There are a few technical issues that need to be addressed before we proceed with a critical discussion of (C). It is not clear that Zimmerman has properly formulated (C). There are two problems with Zimmerman's formulation of (C).

The first problem with Zimmerman's formulation of (C) is that it seems to imply that objects that are extended are nevertheless point-sized (and can stand in contact to boot)! I say that it "seems to" instead of "does" because I am not certain what Zimmerman means by "surface." On one straightforward understanding of this term, (C) does have this implication. Intuitively, we can think of the surface of an object as the region composed of the simples that occupy the boundary points of the object. Here is an example: consider an open sphere *S* of radius *n* around point *p*. Then the surface of *S* is the sum of points that are exactly *n* distance from *p*. The sphere is an extended object. There are parts of its surface that are point-sized. So (C) implies that it is possible for there to be extended objects *that have a point-sized surface*. But the surface of an object just is the sum of its boundary points. If an object has a point-sized surface, this means that it is in fact a point-sized object. So (C) implies that it is possible for there to be extended objects that nonetheless are point-sized. Surely this is unacceptable.

A similar worry about (C) is that it seems to imply that one-dimensional closed objects are possible. Such objects would presumably be counter-examples to the thesis that every extended object is open. The proof is similar to the previous one. Consider our open sphere. Now consider two of the curved lines *L* and *M* that are parts of the surface of the sphere. Given (C), it is possible that there are extended objects *x* and *y* such that *x* has a surface with the shape of *L*, *y* has a surface with the shape of *M*, and *x* and y are in contact. If x and y are embedded in a three-dimensional space, the only way that x and y can have surfaces that are the same shapes as L and M respectively is if x is shaped like L and y is shaped like M. But then x and y are one-dimensional closed objects (that nevertheless are in contact). This sort of result seems unfortunate.

I suspect that Zimmerman intended something much simpler, such as:

> (C*): For any two extended material objects, it is possible for those two objects to be in perfect contact.

Or perhaps:

> (C**) For any two extended material objects with shapes S1 and S2, it is possible for there to be two material objects $x1$ and $x2$ such that $x1$ has S1, $x2$ has S2, and $x1$ and $x2$ stand in perfect contact.[10]

I will concentrate on (C**) in what follows, since it seems to me to be the most plausible of the two. It is not clear why one would hold (C**) and not also hold a more general claim:

> (C***): For any possible material objects x and y, it is possible for objects that are shaped like x and y to be in perfect contact.

Admittedly, it is clear that (C***) is absurd, since it implies that two point-sized objects could come into perfect contact. And, given the continuity of space, this is impossible. But, if this provides a reason to doubt (C***), why doesn't the impossibility of two topologically closed material objects coming into perfect contact also provide evidence against (C**)? When examining Zimmerman's reasons for thinking that (C**) is true, we should also make sure to see whether they also are reasons for thinking that (C***) is true. If Zimmerman's rationale for (C**) also supports (C***), then we shouldn't trust his rationale.

Zimmerman's rationale for (C**) is based on the claim that we should not ascribe repulsive powers to objects simply because they have a certain shape:

> If some configuration of the parts of the surface of an object were such that no objects having those configurations could be brought into contact -- i.e., if (C) were false, -- we would find ourselves forced to posit repulsive powers which must be possessed by all substances having those shapes. .... Thus (C) would seem to be at least a methodologically sensible working assumption, to be given up only as a last resort. [Zimmerman (1996): 12-13].

Zimmerman asks us to consider a case in which a topologically open cube and a topologically closed cube approach each other, starting at 10 feet apart and moving with sufficient force to come into contact after two seconds. Suppose, instead, that in this example there had been two closed cubes. Zimmerman asks us how they are spatially related after two seconds and notes that, given standard topological assumptions *and the assumption that material objects cannot interpenetrate*, they must still be some finite distance apart. Zimmerman writes:

> Was their progress towards one another slower than that of the other pair, or did it stop sooner? In either case, we seem forced to attribute repulsive powers of some kind to the cubes – an ability each cube has to "let the other know" that it has a skin of simples so that, if both the approaching surfaces are closed, the bodies can make sure to slow down or stop. Unless we ascribe repulsive forces to closed surfaces, Bolzano's world becomes one in which a certain class of objects are unaccountably deferential to one another – always just managing to step out of each other's way – while they bang heedlessly into the members of another class of objects. Surely repulsive forces would *have* to be posited to explain such behavior. [Zimmerman (1996):12].

In chapter 2, where I argued that co-located point-sized objects are possible, I wrote:

> Suppose two point-particles are approaching each other at a rapid clip. If co-located material objects are impossible, then they must swerve out of each other's way. Or they must stop dead in their tracks. Or one of them must spontaneously disintegrate. Some event must occur in each world that prohibits them from occupying the same space. There is a *de re* necessary repulsion between these two objects. The price of denying the possibility of co-located objects is accepting brute *de re* modal facts like these. The price is too high.

So I agree with Zimmerman that we shouldn't ascribe repulsive powers to an object simply because it has a certain shape. But the case of point-sized objects approaching each other seems perfectly analogous to the case of two closed objects approaching each other. Zimmerman argues that the friend of extended closed objects can avoid this worry by arguing that they are not wholly composed of simples. Since Zimmerman endorses the Pointy View of Simples, it is clear that he cannot avoid the analogous problem that arises when considering point-sized objects by arguing that *these* objects are *not* wholly composed of simples.

Because Zimmerman is loathe to surrender (Matter) and accepts (C**) in order to avoid postulating repulsive powers, he rejects the possibility of closed objects that are composed entirely of point-sized simples. The analogous move to make in the second sort of case is to reject the possibility of point-sized objects. But this is surely overkill. A more conservative move would be to give up (C**) and avoid postulating repulsive forces by denying Matter. This is the course I recommend following.

Both (C**) and Matter are employed in Zimmerman's defense of premise (2). So Zimmerman's defense for (2) has been undercut. Consequently, Zimmerman's argument fails to establish that, if continuous extended material objects exist, then there is material atomless gunk.

4.4.3 A Coherent Conception of Material Atomless Gunk

However, although Zimmerman's argument does not establish the possibility of atomless gunk, Zimmerman's project is not necessarily doomed. The conclusion that Zimmerman aimed to establish is very strong: any possible world that contains continuous extended objects contains material atomless gunk. But Zimmerman's purposes would be equally served if he could establish the weaker claim that *some* possible worlds that contain continuous extended material objects also contain atomless gunk.

Zimmerman describes two different metaphysics of continuous material objects, which he calls the "Whiteheadian Metaphysics" and the "Brentanian Metaphysics." Both of these theories about the nature of continuous material objects postulate atomless gunk. If at least one of these metaphysics is exemplified by objects at some possible world, then atomless gunk is possible. So we should examine these two theories and see whether we have reason to think they are true of objects at some possible world.

I will argue that the Brentanian conception of material atomless gunk is not tenable. However, the Whiteheadian conception of material atomless gunk is tenable.

Let us now turn to a discussion of the Brentanian theory of the nature of extended continuous material objects. As Zimmerman states the view, the Brentanian metaphysics is a conjunction of five theses:

(i) All continuous extended objects are closed and hence have a skin composed of point-sized simple parts.

(ii) All continuous extended objects are partially gunky.

(iii) *x* and *y* are in contact just in case *x* has a point-sized part *p1*, *y* has a point-sized part *p2*, and *p1* and *p2* are co-located.

(iv) All point-sized parts of material objects are ontologically dependent on the existence of the extended wholes that they are part of. That is, if *x* is a point-sized part of *y*, then, necessarily, *x* exists only if *y* exists.[Zimmerman (1996): 34].

(v) The existence of point-sized entities is entailed by the existence of extended material objects. That is, necessarily, if an extended material object exists, then point-sized objects located at the boundary points of this object exists. [Zimmerman (1996): 28].[11]

My first worry concerns (iv). Consider an extended object *E* and a point-sized part of the object *p*. Now consider the object that is mereological remainder of *E* minus *p*. Let us call this object *E-*. *p* and *E-* are entirely distinct; they have no parts in common. Given that these objects are entirely distinct, there should be no necessary connections between them. But then there should be a possible world in which *p* exists and *E-* does not exist. Presumably there is a world like this in which *E* does not exist as well (because *E-* is almost all of *E*). But then *p* is not ontologically dependent on *E*, contrary to (iv).

I suspect that most advocates of Brentanian extended objects will be unmoved by this sort of Humean consideration. So, although I find this argument worrisome, I don't doubt that it won't convince the advocate of Brentanian extended objects. So let us attend to other concerns about the view.

My second worry is about (i). The Brentanian grants that objects have point-sized parts. In fact, they have point-sized parts located at each point-sized sub-region of the region exactly occupied by the extended object. This is because the Brentanian accepts DAUP and maintains that each arbitrary undetached part of an object is in contact with the remainder of that object, and, given (iii), contact can occur only when there are spatially coincident point-sized parts of the objects in contact. Let us attend to the set of simples *S* that collectively exactly occupy an open sub-region *R* of the region of space exactly occupied by an extended continuous material object. *R* is a continuous three-dimensional region of space. If there is a fusion of the elements of *S*, then that fusion is an open object that is nonetheless both continuous and extended. So the Brentanian is committed to denying that there is such an object. But then the Brentanian is committed to denying the principle of unrestricted composition, which I have embraced. This constitutes my second, and more serious, worry about the Brentanian picture.[12]

I conclude that the Brentanian metaphysics is not viable.

Let us now attend to the Whiteheadian conception of material atomless gunk. According to this conception, every material object is continuously extended in three dimensions. [Zimmerman (1996): 17-19]. On the Whiteheadian picture, material objects do not have point-sized, one-dimensional, or two-dimensional parts. Finally, on the Whiteheadian picture, every material object is gunky since it is not composed of a set of atomic point-sized parts.

Most advocates of Whiteheadian material objects hold that they are located in Whiteheadian spacetime, where a spacetime is *Whiteheadian* just in case it has no parts that are not three-dimensional continuous regions.[13] However, we should ask whether it is possible for there to be Whiteheadian material objects in a classical simplistic spacetime. If we can develop a clear picture of the metaphysics of Whiteheadian material objects in a simplistic spacetime, then we will have conceived of a counter-example to OT.

I will now turn to a discussion of a recent argument against atomless gunk, which can be found in a book by Hud Hudson, titled *A Materialistic Metaphysics of the Human Person*. [Hudson (2001)]. I intend to use Hudson's argument as a foil; although I believe it is unsound, a careful examination of why it fails will provide us with a clear and distinct conception of the metaphysics of Whiteheadian material objects.

4.4.4 Hudson's Argument Against Material Atomless Gunk

Hudson's argument is intriguing for several reasons. First, Hudson directly appeals to specific answers to the Simple Question, which we discussed in chapter 2, in order to settle the dispute concerning the possibility of atomless gunk. Second, Hudson appeals to claims about the nature of spacetime. The overall structure of his argument is as follows:

(a) Either MaxCon or the Pointy View is true.
(b) If MaxCon is true, then atomless gunk is impossible.
(c) If the Pointy View is true, then atomless gunk is impossible.
(d) So atomless gunk is impossible. [Hudson (2001): 84-90].

In chapter 2, I argued that both MaxCon and the Pointy View are false. I won't revisit my criticisms here. I will not challenge premise (b). Instead, I will focus on Hudson's defense of (c).

Hudson's defense of premise (c) consists of the following argument:

(1) The Doctrine of Arbitrary Undetached Parts.

(2) Necessarily, no hunk of material atomless gunk exactly occupies a point-sized region of space.
(3) Necessarily, any hunk of material atomless gunk exactly occupies some region or other.
(4) Necessarily, any region has at least one point-sized subregion.
(5) Necessarily, any point-sized region is exactly occupiable. [Hudson (2001): 88-89].

Hudson claims that premises (2), (4), and (5) are each supported by an appeal to the Pointy View of Simples. Since (1)-(5) jointly imply the impossibility of material atomless gunk, we have an argument from the Pointy View to the impossibility of atomless gunk. Hudson writes:

> From (1) through (5) we can get the conclusion that material atomless gunk is impossible. Suppose (toward reductio) that there is some hunk of material atomless gunk, H. So, by (2) and (3), H exactly occupies some non-point-sized region–hereby named 'R'. So, by (4) and (5), R has at least one exactly-occupiable, point-sized subregion—hereby named 'P'. So, by (1), H has a part—hereby named 'A'—that exactly occupies P. So, by (2), A fails to be gunk. But … every part of gunk is itself gunk. So, H fails to be gunk, too. Reductio complete. [Hudson (2001): 89].

Let us turn now to Hudson's rationales for premises (1)-(5).

We begin with premise (1). Let us first recall what the Doctrine of Arbitrary Undetached Parts says:

> **(DAUP):** Necessarily, for every material object M, if R is the region of space occupied by M, and if sub-R is *any* occupiable sub-region of R *whatever*, there exists a material object that occupies the region sub-R and *which is a part of M.*[14]

Hudson claims that:

> Many are inclined to admit the possibility of material atomless gunk because they are attracted to a principle known as the Doctrine of Arbitrary Undetached Parts… A historically popular argument to gunk from DAUP and a denial of point-sized objects observes that any extended thing will have a right half and a left half (given some orientation or other), and that the halves in question will each have a right half and a left half, and that the process continues without end. …

> It is hard to see how to motivate the possibility of gunk without something like DAUP, and thus I think the gunk theorists should be inclined to leave premise (1) alone. [Hudson (2001): 88-89].

Let us note that it is possible for someone to reject DAUP and yet believe that gunk is possible. I reject DAUP for the reasons discussed in chapter 3. But I believe that gunk is possible, because I believe that gunky worlds are conceivable and that their conceivability provides as of yet undefeated evidence of their possibility. As I see things, both extended simples and material atomless gunk are possible. We have similar reasons to believe that both are possible, specifically, that they are both conceivable. If you accept the possibility of extended simples, you must reject DAUP. Nonetheless, this does not necessarily undercut any motivation for accepting the possibility of material atomless gunk.

DAUP seems to play a major role in Hudson's argument, since it is DAUP that guarantees that, whenever a material object occupies a region of space, the mereological structure of the material object will be isomorphic to the mereological structure of the region.[15] If we reject DAUP, then we reject this necessary isomorphism. This is why anyone who accepts the possibility of extended simples must reject DAUP. Similarly, we might wonder whether an advocate of gunk could hold that a gunky object could exactly occupy an extended region of space without having parts that correspond to the point-sized subregions of that region. Such an object would have a part at every extended subregion of the region that it exactly occupies and yet have no part at any point-sized subregion. One could even hold that this is possible while accepting the Pointy View of Simples and the remaining premises of the argument. So, without

DAUP, Hudson's argument that the Pointy View of Simples implies the impossibility of material atomless gunk fails.

If one adopts this strategy, then one must reject OT as well. So it seems that it is DAUP that grounds OT.

Let us now turn to premise (2), which states that, necessarily, no hunk of material atomless gunk exactly occupies a point-sized region of space. Hudson points out that, given the Pointy View, this premise is clearly true. Hudson is definitely correct on this issue. For suppose an object exactly occupied a point-sized region of space. Given the Pointy View, this object is a simple. So, given the Pointy View, this object is not material atomless gunk.

We might think that, even if we reject the Pointy View, we still could have good reason to accept premise (2). For example, if we have independent reasons to think that being point-sized implies being a simple, we ought to endorse premise (2).[16] However, the reasons that I gave for rejecting the Pointy View in chapter 2 are also reasons for rejecting the claim that being point-sized suffices for being a simple. In chapter 2, I argued that there can be complex objects made out of co-located point-sized objects. If these arguments are sound, being point-sized is not sufficient for being a simple.

Once we accept that being point-sized does not imply simplicity, we might wonder whether being point-sized at least implies being non-gunky. The counter-examples I proposed in chapter 2 all involved point-sized complex objects that were composed of point-sized simples and hence are not counter-examples to this weaker claim. However, I think that I can produce a counter-example to even the weaker claim. In order to generate the counter-example, I must make use of the Extrinsic Theory, which I employed earlier in chapter 3 when defending the possibility of extended simples. Recall that, according to the Extrinsic Theory, a material object has its shape in virtue of the fact that it bears the occupation relation to a region with that shape. The shape of a material object is fixed by the fact that it bears a relation to a region of space that has that shape.

Let us consider a world *w* in which spacetime is *gunky*. Let us consider a material object, M, that exactly occupies a region of spacetime at this world. Let us assume that the mereological structure of M is isomorphic to the mereological structure of the region it occupies in *w*. So, in *w*, M is itself gunky.

Now the mereological structure of an object is an *intrinsic* feature, whereas the shape of a material object, given the extrinsic theory, is an *extrinsic* feature. And so there is no reason why they should be necessarily correlated. It was this insight that led to the argument that undercut DAUP in chapter 3. Once we see that these two aspects of a thing can come apart, there is no reason to hold that the mereological structure of an object must always match that of the region it exactly occupies. Given this, what is there to stop an intrinsic duplicate of M from exactly occupying a point-sized region of space?

In chapter 3, I claimed that the occupation relation is a perfectly natural relation. Now the instantiation of a perfectly natural relation should not be constrained by the intrinsic properties of its relata. So the fact that an object has a particular mereological structure should not prevent it from occupying a region of spacetime with a particular shape, just as the fact that an object has a particular charge does not limit the regions of spacetime it can occupy. So a duplicate of M should be able to occupy a point-sized region of spacetime. So there is a possible world in which an object with the same mereological structure as M occupies a point-sized region of spacetime. This is a world that contains a counter-example to premise (2).

As Hudson points out, premise (3) seems uncontroversial. Let us attend to premise (4), which states that, necessarily, any region has at least one point-sized subregion. I suspect that here is the place that most advocates of gunk will balk. In defense of (4), Hudson writes:

> Recent and intriguing defenses of a Whiteheadian theory of space — a view that may deserve the description "gunky space" — are available in the literature. The central idea is that one may be a realist about space while taking points to be constructed out of those regions. But, strictly speaking, questions about the occupiability of point-sized regions could not even arise, for there would be no point-sized regions to have questions about. Accordingly, by invoking [the Pointy View] together with DAUP one might reject premise (4) and mount a defense of the possibility of material atomless gunk by appealing to the possibility of an extended material object in gunky space. The problem, as I see it, is that the defense is too strong. The mathematical project of constructing points out of sets of infinitely many, converging, nested, extended regions does not guarantee the metaphysical possibility of gunky space any more than the formal consistency of geometries of arbitrarily many dimensions establishes the metaphysical possibility of four-dimensional space. At most the mathematics helps remove one kind of objection to the relevant proposals. More pressing, however, it seems to me that the claim that "space is gunky" must have its truth-value as a matter of necessity. But then, if we ground our belief in the possibility of material atomless gunk with an appeal to gunky space, we will effectively rule out the possibility of material simples, given [the Pointy View]. And that consequence, I submit, is too high to pay. [Hudson (2001): 90].

I think that the fact that the Whiteheadian theory of space is consistent tells us more about metaphysical possibility than Hudson allows. For, since the Whiteheadian theory of space is consistent, we have excellent reason to believe that there is a possible relational structure that behaves in accordance with this theory. However, I agree with Hudson that the consistency of the Whiteheadian theory of space does *not* show that *space* is a relational structure such that it is metaphysically possible that it behaves in accordance with the theory. In fact, in section 4.2, I presented an argument for the claim that, necessarily, space is not Whiteheadian. The argument presented – if sound – provides evidence that trumps our intuition that space could exhibit the structural features dictated by the Whiteheadian theory.

However, it is important that the reason I gave in section 4.2 for denying that Whiteheadian spacetime is possible are not also reasons for denying that material objects could be Whiteheadian. In section 4.2, I argued that if both simplistic spacetimes and gunky spacetimes are possible, then the degree to which some properties are natural is contingent. No such argument can be generated if we accept the Extrinsic Theory, for the geometrical properties of both gunky and simplistic material objects are inherited from the regions of spacetime that they occupy.

So our intuition that material objects could behave in accordance with Whiteheadian theory is not undercut. So we have defeasible reasons to believe that possible material objects are structured as the Whiteheadian theory dictates. But then we have reason to believe that material atomless gunk is possible.

Notes

[1] Some philosophers also endorse the stronger claim that there are possible worlds at which space (or spacetime) is *partially gunky*. (See, for example, Sider (2000a).) Space is *partially gunky* just in case (i) there are some *xs* such that each of the *xs* is a simple, (ii) there are some *ys* such that each of the *ys* is a gunky region of space, and (iii) space is the fusion of the *xs* and the *ys*. Presumably, one believes in this alleged possibility only if one also believes that CT is true. So I will not provide a separate discussion of this intriguing possibility.

[2] I am assuming that propositions have something analogous to 1[st] and 2[nd] order syntactic structure. Perhaps these propositions are really sentences in a Lagadonian language. See Lewis (1986a): 145-146.

[3] See Armstrong (1989): 44, Armstrong (1997): 166-169, Black (2000), Heller (1998), and Sider (2002).

[4] What follows could probably be fairly described as doing a poor job of reinventing the wheel. I developed these definitions on my own (with Jake Bridge watching over my shoulder), although similar ideas have been developed in Forrest (1996), Gerla (1990) and Roeper (1997).

[5] See Lewis (1986): 120-123 for further development of this response.

[6] See Cartwright (1975) and Zimmerman (1996): 5.

[7] Strictly speaking, this is not quite right, for reasons that will emerge momentarily.

[8] See Sider (2000a).

[9] See Sider (2000a).

[10] Zimmerman has indicated to me in a personal communication that C** better captures his intentions than C did.

[11] Note that this is a *de dicto* necessity. The thesis is not the claim that extended wholes are ontologically dependent on their boundary points.

[12] See Sider (2000a) for a similar worry.

[13] Forrest (1996), which we discussed earlier, provides a lengthy explanation of what a Whiteheadian spacetime would be like.

[14] DAUP is discussed in van Inwagen (1983). My statement of DAUP is slightly different from van Inwagen's, but agrees with Hudson's formulation. See Hudson (2001): 88.

[15] Strictly speaking, this holds only if every region is a *receptacle*, where a region of space is a receptacle just in case it is possible for a material object to exactly occupy this region. If certain regions are not receptacles –for example, point-sized regions – then DAUP does not imply that the mereological structure of a material object will always be isomorphic to the mereological structure of the region it exactly occupies.

[16] For example, Ned Markosian argues that MaxCon entails that being point-sized implies being a simple. See Markosian (1998a).

BIBLIOGRAPHY

Armstrong, D. M. 1997. A World of States of Affairs. New York: Cambridge University Press.

Armstrong, D.M. 1989. A Combinatorial Theory of Possibility. Cambridge: Cambridge University Press.

Armstrong, D M. 1986. "In Defense of Structural Universals", Australasian Journal of Philosophy. (64): 85-88.

Baker, Lynne Rudder. 2000. Persons and Bodies. Cambridge: Cambridge University Press.

Baker, Lynne Rudder. 1997. "Why Constitution is not Identity", Journal of Philosophy (94): 599-621.

Barker, Stephen and Dowe, Phil. 2003. "Paradoxes of Multi-Location", Analysis (63.2): 106-114.

Barnette, R.L. 1978. "Does Quantum Mechanics Disprove the Principle of the Identity of Indiscernibles?", *Philosophy of Science* (45): 466-470.

Bigelow, John. 1996. "Presentism and Properties", in James E. Tomberlin, ed., Philosophical Perspectives 10, Metaphysics Cambridge, MA: Blackwell, 35-52.

Black, Robert. 2000. "Against Quidditism", Australasian Journal of Philosophy (78): 87-104.

Bricker, Phillip. 2001. "Island Universes and the Analysis of Modality", in G. Preyer, F. Siebelt (eds.), Reality and Humean Supervenience: Essays on the Philosophy of David Lewis, Rowman and Littlefield.

Bricker, Phillip. 1993. "The Fabric of Space: Intrinsic vs. Extrinsic Distance Relations", Midwest Studies in Philosophy (XVIII): 271-294.

Broad, C.D. 1946. "Leibniz's last controversy with the Newtonians", Theoria (12): 143-168.

Campbell, Keith. 1990. Abstract Particulars. Oxford: Blackwell.

Cartwright, Richard. 1975. "Scattered Objects", in Keith Lehrer, ed., Analysis and Metaphysics (Dordrecht, Holland: D. Reidel Publishing Company), 153-171.

Chalmers, David. 1996. *The Conscious Mind: In Search of a Fundamental Theory* Oxford: Oxford University Press.

Chisholm, Roderick. 1976. Person and Object: A Metaphysical Study. La Salle, Illinois: Open Court Publishing Co.

Chisholm, Roderick. 1973. "Parts as Essential to Their Wholes", Review of Metaphysics (26): 581-603.

Cortens, Andrew. 1999. Global Anti-Realism: a Metaphilosophical Inquiry (Westview)

Cortes, Alberto. 1976. "Leibniz's Principle of the Identity of Indiscernibles: a False Principle", Philosophy of Science (43): 491-505.

Descartes, Rene. 1985. "The Principles of Philosophy", in The Philosophical Writings of Descartes, translated by John Cottingham, Robert Stoothoff, and Dugald Murdoch, Cambridge: Cambridge University Press.

Evans, Gareth. 1978. "Can There Be Vague Objects?", Analysis (38): 208.

Forbes, Graeme. 1987. "Places as Possibilities of Location", Nous (21): 295-318.

Forrest, Peter. 1996. "From Ontology to Topology in the Theory of Regions", The Monist (79): 34-50.

Forrest, Peter. 1986. "Neither Magic Nor Mereology: a Reply to Lewis", Australasian Journal of Philosophy (64): 89-91.

Francescotti, Robert. 1999. "How to Define Intrinsic Properties", Nous (33):590-609.

Gallois, André. 1998. Occasions of Identity. Oxford: Clarendon Press.

Geach, P. T. 1980. Reference and Generality, 3rd ed. Ithaca: Cornell University Press.

Gendler, Tamar and John Hawthorne. 2002. Conceivability and Possibility Oxford: Oxford University Press.

Gerla, Giangiacomo. 1990. "Pointless Metric Spaces", Journal of Symbolic Logic (55): 207-219.

Gilmore, Cody. (forthcoming). Material Objects: Metaphysical Issues (dissertation, Princeton University).

Ginsberg, Allen. 1981. "Quantum Theory and the Identity of Indiscernibles", Philosophy of Science (48): 487-491.

Greene, Brian. 1999. The Elegant Universe, New York, NY: Vintage Books.

Grunbaum, Adolf. 1973. Philosophical Problems of Space and Time, 2nd edition Dordrecht, Hollansd: D. Reidel.

Haslanger, Sally. 1989. "Endurance and Temporary Intrinsics", Analysis (49): 119-125.

Hawley, Katherine. (forthcoming). "Borderline Simple or Extremely Simple?" The Monist.

Hawley, Katherine. 2001. How Things Persist. Oxford: Oxford University Press.

Hawthorne, John and Theodore Sider. 2002. "Locations", Philosophical Topics (30): 53-76.

Hawthorne, John. 2001. "Causal Structuralism", Philosophical Perspectives (15): 361-378.

Heller, Mark. 1998. "Property Counterparts in Ersatz Worlds", The Journal of Philosophy (95): 293-316.

Heller, Mark. 1990. The Ontology of Physical Objects: Four Dimensional Hunks of Matter Cambridge: Cambridge University Press.

Heller, Mark. 1984. "Temporal Parts of Four Dimensional Objects", Philosophical Studies (46): 323-334.

Hinchliff, Mark. 1996. "The Puzzle of Change", in James Tomberlin, ed., Philosophical Perspectives, 10, Metaphysics Cambridge, MA: Blackwell.

Hudson, Hud. 2001. A Materialist Metaphysics of the Human Person Ithaca: Cornell University Press.

Johnston, Mark. 1987. "Is There a Problem about Persistence?", Aristotelian Society Supplement (61): 107-135.

Jubien, Michael. 1993. Ontology, Modality, and the Fallacy of Reference Cambridge: Cambridge University Press.

Kant, Immanuel. 1998. Critique of Pure Reason, translated by Paul Guyer and Allen Wood, Cambridge: Cambridge University Press

Krecz, Charles. 1986. "Parts and Pieces", Philosophy-and-Phenomenological-Research. (46): 381-400.

Leonard, Henry and Nelson Goodman. 1940. "The Calculus of Individuals and its Uses", Journal of Symbolic Logic (5): 45-55.

Lewis, David. 2002. "Tensing the Copula", Mind (111): 1-13.

Lewis, David. 1999. "Zimmerman and the Spinning Sphere", Australasian Journal of Philosophy (77): 209-212.

Lewis, David. 1997a. "New Work for a Theory of Universals", in Papers in Metaphysics and Epistemology Cambridge: Cambridge University Press.

Lewis, David. 1997b. "Humean Supervenience Debugged", in Papers in Metaphysics and Epistemology Cambridge: Cambridge University Press.

Lewis, David. 1993. "Many, But Almost One", in Ontology, Causality and Mind: Essays in Honour of D. M. Armstrong, ed. by Keith Campbell, John Bacon, and Lloyd Reinhardt Cambridge: Cambridge University Press.

Lewis, David. 1991. Parts of Classes Basil: Blackwell.

Lewis, David. 1988. "Vague Identity: Evans Misunderstood", Analysis (48): 128-130.

Lewis, David. 1986a. On the Plurality of Worlds Oxford: Basil Blackwell.

Lewis, David. 1986b. "Against Structural Universals", Australasian Journal of Philosophy. (64): 25-46.

Lewis, David. 1976. "The paradoxes of time travel", American Philosophical Quarterly (13):145-52.

Lewis, David. 1971. "Counterparts of Persons and Their Bodies," Journal of Philosophy (68): 203-211.

Lowe, E. J. 1988. "The Problems of Intrinsic Change: Rejoinder to Lewis", Analysis (48): 72-77.

Markosian, Ned. 2003. "A Defense of Presentism", in Dean Zimmerman, ed., Oxford Studies in Metaphysics, vol. 1. Oxford: Oxford University Press, 47-82.

Markosian, Ned. 1998a. "Simples", Australasian Journal of Philosophy (76): 213-226.

Markosian, Ned. 1998b. "Brutal Composition", Philosophical Studies (92):211-249.

Markosian, Ned. 1994. "The 3D/4D Controversy and Non-Present Objects", Philosophical Papers (23): 243-249.

McDaniel, Kris. (unpublished a). "Kantian Ignorance".

McDaniel, Kris (unpublished b). "Kant's Second Antinomy and Transcendental Realism".

McDaniel, Kris (forthcoming). "Discrete Space and Distance", Synthese

McDaniel, Kris. 2004. "Modal Realism with Overlap", Australasian Journal of Philosophy (82): 137-152.

McDaniel, Kris 2003a. "Against MaxCon Simples", Australasian Journal of Philosophy (81): 265-275.

McDaniel, Kris. 2003b. "No Paradox of Multi Location", Analysis (63.4): 309-311.

McDaniel, Kris. 2001. "Tropes and Ordinary Physical Objects", Philosophical Studies (104.3): 269-290.

McKinnon, Neil (forthcoming). "Vague Simples", Pacific Philosophical Quarterly.

Mellor, D. H. 1998. Real Time II. London: Routledge.

Mellor, D. H. 1981. Real Time. Cambridge: Cambridge University Press.

Merricks, Trenton. 2003. "Maximality and Consciousness", Philosophy and Phenomenological Research (66):150-158.

Merricks, Trenton. 1999. "Composition as Identity, Mereological Essentialism, and Counterpart Theory", Australasian Journal of Philosophy (77): 192-195.

Merricks, Trenton. 1998. "On Whether Being Conscious is Intrinsic", Mind 107: 845-46.

Mierav, Ariel. 2000. "Non-Unique Composition", Synthese (124): 323-342.

Nerlich, Graham. 1994. The Shape of Space 2nd ed. Cambridge: Cambridge University Press.

Noonan, Harold. 2001. "The Case for Perdurance", in Gerhard Preyer, ed., Reality and Humean Supervenience: Essays on the Philosophy of David Lewis Lanham: Rowman and Littlefield, 123-139.

Oliver, Alex. 1993. "Are Subclasses Parts of Classes?", Analysis (54): 215-223.

Olson, Eric T. 1998. “Human Atoms”, Australasian Journal of Philosophy 76: 396-406.

Parsons, Josh. 2000. “Must a Four-Dimensionalist Believe in Temporal Parts?”, The Monist (83): 399-418.

Parsons, Terence. 1987. “Entities without Identity”, in James Tomberlin, ed., Philosophical Perspectives, 1, Metaphysics Atascadero, CA: Ridgeview Publishing Company.

Rea, Michael. 2000. “Constitution and Kind Membership”, Philosophical Studies (97):169-193.

Roeper, Peter. 1997. “Region-Based Topology”, Journal-of-Philosophical-Logic. (26): 251-309

Rosen, Gideon and Cian Dorr. 2003. “Composition as a Fiction”, in The Blackwell Companion to Metaphysics, ed. Richard Gale, Blackwell.

Scala, Mark. 2002. “Homogeneous Simples”, Philosophy and Phenomenological Research (64): 393-397.

Schaffer, Jonathan. (forthcoming). “Two Concepts of Sparse Properties” Pacific Philosophical Quarterly.

Schaffer, Jonathan. 2003a. “The Problem of Free Mass: Must Properties Cluster?”, Philosophy and Phenomenological Research, (66): 125-138.

Schaffer, Jonathan. 2003b. “Is There a Fundamental Level?” Nous (37): 498-517.

Sidelle, Alan. 2002. “Is There a True Metaphysics of Material Objects?”, Philosophical Issues (12): 118-145.

Sidelle, Alan. 1989. Necessity, Essence, and Individuation: a Defense of Conventionalism. Ithaca: Cornell University Press.

Sider, Theodore. (unpublished). “Parthood”.

Sider, Theodore. 2002. “The Ersatz Pluriverse”, Journal of Philosophy (99): 279-315.

Sider, Theodore. 2001. Four-Dimensionalism: An Ontology of Persistence and Time. Oxford: Clarendon Press.

Sider, Theodore. 2000a. “Simply Possible”, Philosophy and Phenomenological Research (60): 585-590.

Sider, Theodore. 2000b. "The Stage View and Temporary Intrinsics", Analysis (60): 84-88.

Sider, Theodore. 1997. "Four-Dimensionalism", Philosophical Review (106): 197-231.

Sider, Theodore. 1996. "All the World's a Stage", Australasian Journal of Philosophy (74): 433-453.

Sider, Theodore. 1995. "Sparseness, Immanence, and Naturalness", Nous (29): 360-377.

Sider, Theodore. 1993. "Van Inwagen and the Possibility of Gunk", Analysis (53): 285-89.

Simons, Peter. 1994. "Particulars in Particular Clothing: Three Trope Theories of Substance", Philosophy and Phenomenological Research 54: 553-575.

Simons, Peter. 1987. Parts: A Study in Ontology. Oxford: Oxford University Press.

Strawson, Galen. 2003. "Real Materialism", in Chomsky and His Critics, ed. Louise Antony and Norbert Hornstein, Oxford: Blackwell.

Teller, Paul 1983. "Quantum Physics, the Identity of Indiscernibles and Some Unanswered Questions", Philosophy of Science (50): 309-319.

van Cleve, James. 1987. "Right, Left, and the Fourth Dimension", The Philosophical Review (96): 33-68.

van Inwagen, Peter. 1994. "Composition as Identity", in J. E. Tomberlin (ed.) Philosophical Perspectives 8, Logic and Language Atascadero, CA: Ridgeview, 207-220.

van Inwagen, Peter. 1990a. Material Beings. (Ithaca: Cornell University Press).

van Inwagen, Peter. 1990b. "Four-Dimensional Objects", Nous (24): 245-255.

van Inwagen, Peter. 1986. "Two Concepts of Possible Worlds", Midwest Studies in Philosophy (XI): 185-214.

van Inwagen, Peter. 1981. "The Doctrine of Arbitrary Undetached Parts", Pacific Philosophical Quarterly (62) 123-137

Varzi, Achille. 2000. "Mereological Commitments", Dialectica (54): 283-305.

Wasserman, Ryan. (forthcoming). "Review Article: Hud Hudson's A Materialist Metaphysics of the Human Person", Philo.

Wasserman, Ryan. 2004. "Framing the Debate over Persistence", Metaphysica (5): 67-80.

Wasserman, Ryan. 2002. "The Standard Objection to the Standard Account", Philosophical Studies (111): 197-216.

Wiggins, David. 2001. Sameness and Substance Renewed. Cambridge: Cambridge University Press.

Williams, Donald C. 1951. "The Myth of Passage", Journal of Philosophy (48): 457-472.

Yi, Byeong-uk. 1999. "Is Mereology Ontologically Innocent?", Philosophical Studies (93): 141-160.

Zimmerman, Dean W. 2002. "Scala and the Spinning Spheres", Philosophy and Phenomenological Research (64): 398-405.

Zimmerman, Dean. 2000. "Could Extended Objects Be Made Out of Simple Parts? An Argument for Atomless Gunk" Philosophy and Phenomenological Research (56): 1-29.

Zimmerman, Dean. 1998. "Temporary Intrinsics and Presentism", in Zimmerman and Peter van Inwagen (eds.), Metaphysics: The Big Questions, Cambridge, MA: Blackwell.

Zimmerman, Dean. 1996. "Indivisible Parts and Extended Objects: Some Philosophical Episodes from Topology's Prehistory", the Monist (79): 148-180.

Zimmerman, Dean W. 1995. "Theories of Masses and Problems of Constitution", Philosophical Review (104): 53-110.